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UNIVERSITY OF CALIFORNIA
COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION, Berkeley

OUTLINES OF COURSE OF INSTRUCTION IN
AGRICULTURAL NATURE STUDY FOR THE
RURAL SCHOOLS OF CALIFORNIA

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The following pages contain suggestive material for the use of teachers in the Rural Elementary School or in any elementary school in California for that matter. The teacher is urged to make selection suitable to her own environment.

A. The material that follows is grouped under four general topics, viz.:

1. Human Needs, Interests, and Activities.
2. Plant Life throughout the Year.
3. Animal Life throughout the Year.
4. Natural Phenomena and the Inorganic World, and Soil Studies.

B. Since human needs are considered, the physiology and hygiene for the first six grades are included in nature study. The instruction in physiology and hygiene may be given during the worst weather of the winter months, when there is more need of emphasizing the care of the body and the observance of health conditions in general. Besides, this work lends itself to indoor instruction when weather conditions forbid much outdoor work. If desired, an elementary text as *Health Lessons, The Body in Which We Live*, etc., may be used as a health reader in the Third, Fourth, Fifth, and Sixth grades. Of course for the First and Second grades all instruction in health lessons and nature study is oral.

I. OUTLINES FOR FIRST GRADE

Children of the First and Second grades want to know their environment in a large, general way and are not old enough to be interested in minute details.

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1. HUMAN NEEDS, INTERESTS, AND ACTIVITIES

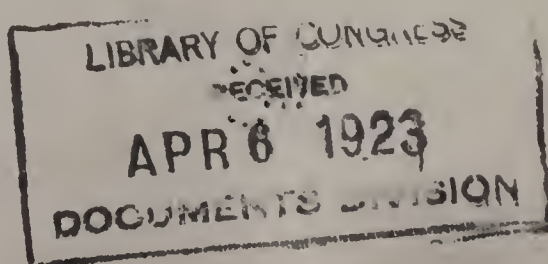
Informal talks with the children about their homes, to make them feel at ease in the school and to show them that the school is interested in the home life of its pupils. Encourage each child to have a part in these conversational lessons, thus giving opportunity for drill in correct oral expression on things related to the life of the child.

The home.—The house and the need of shelter. Materials that enter into the construction of the house. Where obtained? Labor needed in the construction of the house. Heating ways: lighting, as



candles, lamps, electric, gas; water in the house. Description of the house, rooms with furnishings, conveniences, etc. The surroundings of the house, the lawn with its trees, shrubs, vines, and flowers. Changes about and in the house because of seasonal changes in weather. Health and hygiene of the home. Duties of the various members of the household in making the house attractive and comfortable. Ideas in coöperation with certain activities. Find out what the child does or contributes to this social service. Play activities of the children at home; the pleasures of family life, the visits of neighbors, etc.

Food.—A second fundamental need. Have the children name all the different foods that come from the garden; from the field; from the orchard; from animals; from the store. When harvest and how store products of garden, field, and orchard? Provisions for the future. Changes in certain articles as wheat into flour, etc., processes, where and by whom. Things that cause a shortage of food. Work of various members of the household in growing and the preparation of food. Duty of the child as an economic factor. Needed articles of food—salt, sugar, etc.—not grown or found in the pupil's locality or state.



Clothing.—A third fundamental human need. Kinds of clothing, woolen, linen, cotton, silk, leather, etc., and where each is obtained. Uses of clothing. Seasonal changes and adjustments of clothing. Talks about clothing and drygoods stores. Preparation of clothing. Care and hygiene of clothing. Clothing for indoors and out-of-doors. Clothing of primitive people.

Health lessons.—Any good elementary text in physiology and hygiene will furnish abundant material as the basis of many important health talks. Air, food, and water necessary to sustain life. How does air become impure? Bad odor in the room, how caused? Need



of ventilation and how obtained. Work of the lungs. Why keep the skin clean? How often bathe? Care of teeth, hair, face, hands, and nails. Keeping school materials clean; desks, books, drinking cups, etc. Preparation of foods. Best ways of cooking different foods. Name foods best suited for the different meals. What constitutes a good school lunch? Manner of eating. Various items in housecleaning after the winter or rainy season is over. Cleaning of the yard. Children help in housecleaning.

Seasonal activities.—Character of work on the ranch during the dry season, haying, harvesting grain, picking fruits, etc. After sufficient rain, the plowing and seeding. The annual pruning of orchards and vineyards, why? The spraying of fruit trees, etc., why? Cultivation of orchards and vineyards, why? Conservation of water supply, irrigation. Dust in roads, how controlled? Special industries as canning, pickling, lumbering, etc., in the particular community.

Institutional life.—Need of a schoolhouse, a church. Human activities that cause the need of other public places, such as the store,

creamery, blacksmith shop, post office, depot, factory, etc. Value of good roads. Emphasize the ideas of interdependence and the spirit of service. What things can the children do to make and keep the schoolhouse and grounds wholesome and attractive?

2. PLANT LIFE THROUGHOUT THE YEAR

Building up an appreciation of good things on the part of young children can be accomplished through the study of nature if the teacher has the proper "background" of appreciation of excellence in plant and animal life. The more detailed study must be left to the upper grades. Primary children are interested in whole objects



rather than in parts, and in useful objects rather than those which seem to have no direct service. Bailey's book, *The Holy Earth*, has some excellent chapters for the teacher of nature subjects. See chapter, *Admiration of Good Materials*.

Fruits.—Have children name different fruits and nuts that grow in the district. Name those that have ripened before school opened or that are now ripe. If possible let each child bring to school the best peach, pear, apple, orange, lemon, walnut, olive, bunch of grapes, etc., grown at home. Talk about points of excellence in form, color, flavor to develop that "Admiration of Good Materials" mentioned by Bailey. The husbandry necessary to produce perfect fruit.

Fruit trees.—Names of various kinds in the neighborhood. General appearance. Do leaves stay on all winter? Watch for the blossoms in the proper season. General talk about the care of fruit trees. Each child describes his favorite fruit tree at home and tells why the tree is a favorite.

Shade or ornamental trees.—Identification, and items of interest about the common ones found around the homes or on the school road. Why protect the trees? Color of foliage.

Forest trees.—Names and general appearance of any that may be found in the neighborhood. The pine or fir and Christmas stories.

Wild flowers.—Any wild flowers in blossom during the dry season? What came back to life with the rainy season? After the snow passed away? Make a list on the blackboard of a dozen or so of the most common wild flowers. Collect seeds of a few to plant. Avoid wanton destruction of blossoms.



Cultivated flowers.—Acquaintance with a few of the most common found around the homes as geraniums, nasturtiums, verbenas, morning glories, petunias, sweet peas, etc.

Field plants.—Children name the different plants that are useful as wheat, oats, alfalfa, etc. Distinguish a head of wheat from a head of oats. Names and identification of two or three noxious plants or weeds grown in the fields.

Garden plants.—Discussion in general terms about the kinds of plants grown in the garden, uses, etc. What things helped the plants to grow? Who took care of them? Suggestions to children to save a few seeds for their own garden next year. Who makes a garden and what things are done?

Thanksgiving Festival.—Good moral teaching to celebrate the yearly bounty of garden, field, and orchard. Story of the Puritans. Display of best farm products in the school. Arrange exhibits with reference to color effects and educational influences. Use of both cultivated and wild common products. Make the exhibit a special

occasion for the community. All grades of the school must have a part in this. There need be no competition or prizes even, simply a show for its own sake.

3. ANIMAL LIFE THROUGHOUT THE YEAR

Common domestic animals.—Name the various animals of pasture and barnyard. The pets of the household, poultry, etc. Have children talk about care of animals, the service they render in the way of labor, food, and pleasure. Emphasize the cow and the hen. Emphasize cleanliness of cow-barn and chicken house. Sanitary milk and egg production. Create appreciation of the best in animal life.

Wild animals.—Name such as may be found in the locality, rabbits, gophers, deer, bear, etc. Which are injurious to the farmer and how? Means taken for extermination of enemies to plant and animal life on the farms.

Birds.—What birds are present when school opens? What have gone? Which come with the rainy season? Which with the opening of spring? What ones stay all winter? Make a few simple observations on two or three of the most common birds during the year. Find out what the children already know about birds, create in them a desire to know more about bird life, and leave to the other years a progressive study of details.

Insect life.—Interest the children in watching grasshoppers, butterflies, bees, etc. Do not make this first year an intensive study in economic entomology. Have them know what an insect is, if they do not know. Have them know in a general way about two or three common insects injurious to garden, field, and orchard. Detailed study in later years.

4. PHYSICAL PHENOMENA AND THE INORGANIC WORLD

Weather.—Effects of long, dry season, change of season, rain, clouds, winds, snow, ice, frost, etc. The weather calendar and use of the thermometer.

The brook.—Action of running water, stones, pebbles, sand, erosion, gulleys, etc.

Soil.—Appearance in dry season and in wet season. Dust, mud.

II. OUTLINES FOR SECOND GRADE

1. HUMAN NEEDS, INTERESTS, AND ACTIVITIES

Summer vacation experiences.—Outings, picnics, fishing trips, visits to friends or relatives, etc. Work done by the children about the home, in the garden, or in the fields. New things they have learned since school closed in the spring.

Health lessons.—Talks about good articles of food for the various meals. Proper breakfast materials, summer and winter, for children, as eggs, milk, fruit, cereals. Manners in eating. Thorough chewing and proper digestion. The school lunch, character, and how eaten. Ways of making the school lunch more hygienic. Duty of the home and the school. The muscles. Development through activity, as in work and play. Muscular activity and good food and fresh air. The hands and nails, why kept clean? Comfortable shoes and frequent bathing of the feet, why important? The eye, its importance and care. Proper light for reading. Danger in poor light. When to use glasses. Testing the eyesight. Proper lighting of a schoolroom. Things to be observed in the care of the ear. Danger of sudden and loud noises. Deafness, cause and inconvenience. The pleasant voice and how acquire it.

Seasonal activities.—Kinds of work performed on the farm throughout the year. Children report on practice of farmers in preparing the ground for seeding, setting out trees, for irrigation, etc. Preparations for the home garden. Why cultivate the growing crops? What is done with the various crops after they are harvested? What did each child do in the various farming operations?

2. PLANT LIFE THROUGHOUT THE YEAR

Garden crops.—Name different plants growing in the garden. When was the seed planted? What care has the garden received during the summer? Mention any vegetables in the garden that have gone to seed, as radish, lettuce, peas, corn, beans, etc. Gather some seed and save for planting in the garden in the spring. Study in detail the radish or lettuce plant gone to seed, noting root, stem, blossom, seed pods, and seeds. Any vine crops in the garden. During winter months arouse interest in the children for the spring garden work. Children help to make the window garden in the schoolroom. Preparatory talks on the kind of box to hold the soil, the best kind of

soil to put into the box, and the best seed to plant with a view to transplanting at home. Encourage the idea of the "school-home" garden with the possibility of the school exhibit of plants grown at home. The "egg shell" garden especially appeals to children of the first two grades. Discussion of things that may be planted during the rainy season. When rainy season is over or winter has passed, discuss, when soil is dry enough to work, how to prepare the seed beds for sowing seeds or transplanting from window gardens or egg shell gardens. Why transplant? Show how this should be done. Do not try to grow too many different kinds. Emphasize one vegetable and one flower to be grown by young children at home, the products of



which, either fruit or blossoms, may be exhibited at school the next fall. Suggest tomato or potato for the vegetable and aster or cosmos for the flower. Have a good seed catalogue, well illustrated, in the schoolroom and examine the pictures of garden vegetables and flowers. Children of this grade may plant seeds of gourds or some other vines to cover fence or screen outbuildings.

Field crops.—Have children report the different field crops grown in the community. Why grown? Do the farmers grow all their feed for their live stock? If not, where do they get it. What is the principal cereal? If wheat, corn, or oats, name the different varieties. How is each crop harvested? How is it stored away for future use? If potatoes are not grown locally, where do people get their supply? What grasses, alfalfa, vetch, clover, etc., are grown by the farmers? How many families grow sugar corn or pop corn? How many grow pumpkins or squash in the fields? Begin to emphasize the value and need of a more diversified agriculture so that a community need not be dependent upon a single crop.

Fruit crops.—Name different fruits grown in the district. Make a list on blackboard of fruits of trees, vines, and shrubs, as peaches, apples, prunes, oranges, grapes, olives, almonds, raspberry, currants, strawberries, etc. How can fruit trees be told apart when there is no fruit on them? Have leaves and twigs from different trees in the schoolroom. Why are trees and vines pruned? Watch the blossoms in the trees. What are the bees doing? What is one injurious insect for each fruit tree? How is the spraying done? What ripens the fruit? What labor is required to have good fruit? What is done



with the fruit when picked? If in a raisin, walnut, or olive district, emphasize best methods of preparing crop for the market. Teacher should get all possible information from the best growers in the community. Don't attempt to bring out all the technical information in the primary grades. Leave something for the upper grades.

Shade and forest trees.—Identify a few of the most important shade trees. How tell an acacia from a black walnut? How tell the valley oak from the black oak? What is the principal shade tree in the community? How many kinds of eucalyptus grown in the neighborhood? Do the leaves stay on all the year? How tell one pine tree from another? How many of the trees have blossoms? When does each tree blossom? Do they have seeds? If so, collect a few. How does the seed of the maple differ from the seed of the oak? Choose one tree to find out all the interesting things possible, as age, height, shape, manner of growth, direction of branches, color of leaves, limbs, and bark on trunk, the buds, shape of leaf, etc. Notice twigs and leaves of two or three other trees in contrast to the one chosen. The

forest and what it means to mankind. Lumbering and reforestation. How observe Arbor Day in the best way? Are trees needed on the school ground?

Native shrubs.—Any growing on the mountain side? In the cañon? Along the streams? In the open? Make a list of the wild shrubs in the neighborhood. Study one as to height, character of stem and branches, kind of leaf, color of blossom, etc. Can some of these



hardy native shrubs be transplanted? What are some of the things necessary to successfully transplant a shrub, tree or flower? Does the school yard need shrubs and flowers as well as trees?

Wild flowers.—What wild flowers are in blossom when school opens? Put list on board. What ones have gone to seed? Collect a few seeds. Some autumn flowers may be used for schoolroom decoration. Teach children how to gather wild flowers—a few for enjoyment and not for destruction. Suit the length of the stems to the depth of the receptacle. Make artistic bouquets of both autumn and spring wild flowers, showing what colors harmonize. Harmony of colors is fundamental to the creation of good taste in clothing and household furnishings. What wild flowers are revived by the rainy season?

What ones blossom after the snow is gone? What ones blossom before school closes? Put list on the board. Keep a wild flower calendar. Talk briefly about the conditions under which wild flowers grow. What is each child's favorite wild flower? Start a wild flower garden in one corner of the school yard.

Cultivated flowers.—From conversations with pupils make a list on the board of all different varieties of cultivated flowers growing around the various homes in the district. Find out a few things as



to their care and value about the home. How many of these varieties are found on the school ground? When do these various flowers blossom? Are they grown from seed? Is it necessary to sow the seed every year? If not started from seed, then how? Test observation and interest by asking children to watch certain plants for a week and report all things of interest they may see. The detailed study of any flowering plant, wild or tame, should be left for later years.

Harvest Festival.—The crowning event in the study of plant life during the year should be the exhibition in the schoolroom of the best products of the field, orchard, garden, and roadside. This, of course, should be participated in by the entire school. Thanksgiving is a good time for this expression of appreciation of the earth's goodness.

3. ANIMAL LIFE THROUGHOUT THE YEAR

Common domestic animals.—Name animals on the farm that work for us. What does each one do? What does each animal eat? How are these animals housed? What constitutes a good barn, poultry house, etc.? In what ways is the horse useful? Why can a horse do certain kinds of work better than any other animal? How is a horse trained to work? Discuss harness and its fitness for the horse. Mention all the things a horse needs every day. When does a horse need special care? In what way? Why do horses need shoes? Discuss difference between the horse that pulls a heavy load and the one for



the light buggy. If possible show pictures of various kinds of horses and ponies. In like manner make a somewhat detailed study of the dog. Each child to tell why the dog is a friend to man. Tell the various ways that a dog is useful on the farm. Show pictures of dogs. What does a dog like for food? Watch one eat. Tell how he does it. What kind of teeth has he? Children will enjoy some good stories of dogs.

Wild animals.—What wild animals in the community? How do they live? Where do they spend the winter? What ones are injurious to the farmer? In what ways?

Birds.—Make a list on the blackboard of the birds present when school opens. How recognize different birds—color, song, size, manner of flight, etc.? What birds stay all winter? What ones return when spring comes? What is the food of birds? Where do they stay at night? Name various places where birds build their nests. Watch

them building their nests, feeding the young, and teaching them to fly. Keep a bird calendar, noting when each bird is first seen. How are birds useful to us?

Insect life.—Notice any insects found in connection with the garden or any plant life studied during the year. Describe them in a general way, giving size, color, markings, etc. What are these insects called, their common names? What is the food of insects? How do they get their food? Perhaps by observation they may learn that insects are grouped into two general classes according to the way in which they get their food, viz.: the biting and the sucking. This knowledge is necessary in order to use the proper spray to kill the injurious insects. Spraying and a more detailed study of the insects to be left till the upper grades.

4. PHYSICAL PHENOMENA AND THE INORGANIC WORLD

Weather calendar.—This should be kept each month, noting days of sunshine or clouds, rain or snow, etc. Temperature, direction of wind can be indicated. Also note changes of seasons. Why the days grow longer or shorter. What is the longest day? The shortest?

Sky studies.—Where does the sun rise? Set? What direction is the sun from us at noon? What is meant by new moon? First quarter? Full moon? Last quarter? How does the moon shine? How often do we have full moon? Look at the sky on a clear night. What do you see? What is the "Milky Way"? Look for groups of bright stars. One group is called the Great Dipper. How many stars in this group? Can you see the two stars called the "pointers"? To what do they point? Why is it important to know the North Star?

Rain.—What is it? How caused? What good does the rain do? What damage at times? How are clouds formed? What is a fog? How do hail and snow differ from rain? How many inches of rainfall in your district? What is a rainbow? Tell about the colors. Does the snow ever fall in your part of the state? If so, how deep does it get at times? What good do you think the snow does?

The brook.—Appearance during the dry season. What change after the rain has fallen for a few days? Where does this particular brook have its beginning? Its end? In what ways is the brook a busy worker? Under what conditions does it do the most work? The least work? What causes the difference in the color of the water? Are there any small stones or pebbles in the brook? Are they rough or smooth? Why? Bring out the thought of running water as a force in soil formation. Watch a section of the brook during one rainy season and report changes in appearance.

III. OUTLINES FOR THE THIRD GRADE

Pupils of the Intermediate grades, the Third, Fourth, Fifth, and Sixth want to know more details.

1. HUMAN NEEDS, INTERESTS, AND ACTIVITIES

Seasonal activities.—First, harvesting. When school opens discuss somewhat in detail the work that is being carried on to harvest the crops of field, orchard, and garden. How does the yield compare with last year? How are prices? Any scarcity of labor? What is



the olive crop worth in your district? Or the orange? The apple? Or whatever is the special crop? If only one crop is raised in a community, what would likely be the result if that crop should fail? What is a diversified crop system? What are its benefits? What is the last thing to be harvested in the fall? The first in the spring? What part do the children have in the harvesting process? In field crops take wheat or alfalfa and discuss the best methods in the preparation of the seed bed. Have children observe practices of best farmers. How deep should the planting be? Why? The work to be done preparatory to setting out an orchard or a vineyard? Third, miscellaneous activities as pruning, spraying, care of livestock, poultry, etc. In a measure better methods of work on the farm can

be emphasized, but the chief purpose is to magnify the importance of the farmer's work and to dignify honest toil in general. More detailed instruction and observation, of course, are left for the Seventh and Eighth grades.

Seasonal needs.—Changes in weather related to human comfort as to food, clothing, and shelter. Contrast requirements in July with those in December. The wisdom of "looking ahead" on the farm. Reasons why the farmer should plan for six months or a year in advance. Storage of food.

Social interests.—The year's picnics, excursions, fishing trips, fairs, parties, patriotic celebrations, etc. What is the school doing to develop the social idea? Play on the school ground, social value. Meetings in the schoolhouse, their community value. Discussion of various institutions and organizations that are helping to give a better community life. Is there a rural church, a grange, a farm bureau in the district? Find out if possible their programs of work.

Health needs.—Hygiene for the individual in the school and home and for the community at large. Refer to books on physiology for topics with reference to breathing, ventilation, the five senses, and first aid. Discussion of contents of some one bulletin from State Board of Health as to drainage or water supply, or the fly or the mosquito. Do not attempt to cover the whole field of rural sanitation in this grade. Leave a few matters for the upper grades. Select some one phase and do as thorough work as is possible, considering always the capacity of the ones taught.

2. PLANT LIFE THROUGHOUT THE YEAR

Garden studies.—Each child make a list of all vegetables grown in the home garden. When were the seeds planted? Who helped in the summer garden work? What is the fall appearance of the home or school garden? Name vegetables that have been used or that are now ready for use. The same with flowers. What parts of vegetables are used for food? What ones are being stored for future use? Where and how? What seeds are collected for spring planting? What vegetables remain in the garden during the winter or rainy season? Discuss preparations for garden work in the spring. If not possible to have a little plot on the school grounds, encourage the home garden. In either case have a window garden in the schoolroom. Plant a few quick growing vegetables, as radish, bean, pea, to observe germination and growth. Have a flower box with geranium slips and nasturtium seed for a beginning. Plan for a school exhibit next year.

The Tomato.—Why a good plant for detailed study? In what ways valuable as food? Inspection of growing plant in garden with pupils, if possible. Questions on board for children to answer if not possible to inspect growing plant. Position of growing plant. Stems and general character of growth contrasted with other plants. Look for flower, color, different parts. Where is the flower found? What part stays on to make the fruit we eat? Name of this part? Have three or four ripe and green tomatoes of choice varieties in the schoolroom to study characteristics that make a good tomato.



The Morning Glory.—Begin to emphasize the climbing plants, their value about home and school and interesting points in their manner of growth. Children report all kinds of climbing plants they can think of. Take one, as the morning glory, for a type study. How can it grow so high? What kind of stem has it? How does it hold on to things? Look at the leaves, telling how many on a stem and where do they grow? Why is this a good vine about our homes? Note the position of flowers. Where do the blossoms open? What does the bud look like? When does the morning glory begin to bloom?

Wild Morning Glory or Bindweed.—This is a very noxious weed. Certain phases of this plant may be reserved for study in higher grades. But in connection with the study of the tame morning glory certain points of resemblance may be noted in the wild morning glory.

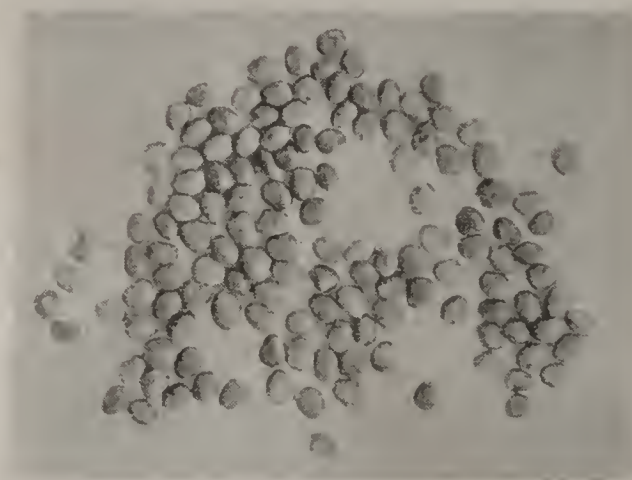
The Thistle.—Where do they grow? Are they alone or several together? How are the leaves arranged on the stem? Are they smooth or hairy on one side or on both sides? Where are the spines, around the margin of leaves or on the ribs and veins? Look at the edges of the leaves and tell what you see. How does the flower grow? Which open first, those at the top of the stalk or those lowest on the stalk? Do the row of flowers at the outer edge of the head open first or those at the center? Color of blossom? Any fragrance? What insects visit the thistle blossom? How are the flower heads protected? Carefully cut away the protection and note how the seeds are placed. Count the number of seeds in one head. Tell all that you can see about one seed.



Wild flowers.—Enumerate the wild flowers of the district or vicinity that are going to seed when school opens; those that are in blossom during the autumn months. What are the prevailing colors of the autumn wild flowers? Of those that blossom during the spring? Collect wild flower seed for spring garden work. In fall and spring have wild flowers in the schoolroom (the blossoms). Teach pupils to collect a few only of each kind with as long stems as possible. Arrange in artistic mass effect in simple flower holders. Teach harmony of color. The same will apply, of course, to cultivated flowers.

Nut trees.—Name all trees of orchard or forest whose nuts ripen in the fall. Have children appreciate the life and work of trees in general and the special value of nut trees for ornamentation and food. Bring samples of various nuts to school. If oak trees are near, bring in leaves as well as acorns. If the black walnut is available, make a special study of it. Put a few questions to stimulate observation on the board and ask children to find the answers from observing

some walnut tree. Is the tree tall or short? Bark rough or smooth? Anything peculiar about the furrows in the bark? Are the branches near the ground? Are they large or small? Is the bark on the branches of same color as that on the trunk? Watch in the spring to see if there are any flowers on the walnut tree. Is the wood of the walnut tree good for anything? Where do you find the nuts on the walnut tree? Do the nuts fall before the leaves? Describe a walnut. Where is the real seed that grows to make another walnut tree? Take a few twigs indoors for observation. Look for tiny buds for next spring, leaf scars, and rings showing the year's growth. Notice the kind of leaves the walnut has. If the black walnut is not in the neighborhood, then take some other nut tree.



Seed germination.—With the coming of seeding time in the locality, whether for garden or farm crops, the attention of the children should be called to the planting of seeds. What is a seed? What kinds are planted? Name all garden seeds that are usually planted at the close of the rainy season or the passing of the snow. Teach the necessary conditions to grow seed, if in soil, the soil must be warm, moist—not wet—sunshine and air.

Radish seed.—Plant some in moist sand in a shallow box, keep moderately moist and warm, and dig up two or three from day to day to watch changes. Plant enough and have the box large enough so that several plants may make some growth. Or place seed between folds of damp cloth or blotting paper laid on a plate or saucer. Put in a warm place and watch the seed-leaves and rootlets put forth. As soon as the shell opens, note how the seed-leaves or cotyledons are folded. Describe all you see. What is the appearance of the root? A further detailed study of the grown radish is left for an upper grade.

The Pea.—Allow a quantity of peas to stand in water for a day. Compare a soaked pea with a dry one. How do they differ and what

has caused the change? Place a few dry ones in moist soil and see what would happen. Remove covering from soaked seed. This is seed coat. Note two thick pieces called cotyledons. What holds the cotyledons together? Discuss conditions necessary to grow garden peas successfully. Encourage each child to prepare a small bed at home and plant some peas. Discuss value of peas as food. A lesson on the sweet peas may be given in connection with the study of common peas. Teach the soil conditions best for growth of sweet peas. If possible, plant some on the school ground. Each child should be encouraged to grow some at home.

The Autumn Festival.—Before school closes for the year discuss plans for the coming school fair. Get the coöperation of the parents during the summer vacation. Appoint the necessary committees. Urge each child and adult to exhibit the best specimens of whatever they have grown.



3. ANIMAL LIFE THROUGHOUT THE YEAR

Insect life.—What butterflies are seen during the first two weeks of school. How do insects get ready for winter? Have children watch for catterpillars. Give all items of interest about them. How many feet? Color of head? How do they eat? What is their food? Put some in a pasteboard box and feed them. Watch for cocoons. Cut open one cocoon. What is on the inside? What insects are busy at work in the garden? Watch for spiders. Find a spider's web and report about it. What insects appear first in the spring? Where found? What ones are destructive to fruit orchards? How are they removed? Have pupils see the difference between a biting insect and a sucking insect. Methods of control with reference to manner of getting food.

Bird life.—What birds remain all the year? What birds destroy insects and worms on trees? How many have seen a woodpecker?

Watch work and movements and report. Make a special study of the English sparrow if there be one in the vicinity; where it stays, feeds, disposition, etc. Try to identify different birds by their manner of flight. What is the food of birds during the winter time? Observations on nest building and care of the young. Make a bird calendar.

Domestic animals.—Review work and worth of the common domestic animals on the farm as outlined in second year. The *Cat*, why have one about the house? What is its food? What does it do? Describe eyes, ears, claws, etc. What are its whiskers? What are the wild relatives of the cat? Who has a *Dog* at home? Of what use is he? Tell about his care, habits, wild relatives, etc. General study of *Hen*. Where do they make their nests? Eggs, sizes and colors. Setting a hen. *Chickens*, their food, care and enemies. Simple requirements of a good poultry house. Its care. Shelter for farm animals.

Wild animals.—Name all found in the vicinity. What ones are injuries to cultivated crops? In what way? How exterminated? Make a special study of the squirrel or rabbit, food, manner of life, appearance, value, etc.

4. PHYSICAL PHENOMENA AND THE INORGANIC WORLD

Weather and temperature.—Study of the thermometer, its uses, and how it works. Use of mercury and alcohol. Place thermometer in various parts of the room and note the readings. Put a weather calendar on the board and on it record daily temperature of outside air from readings of thermometer hung on the outside of the school-house for a few minutes. What is temperature? What makes weather?

The Moon.—Appearance when it is full. Difference in appearance between the new moon and the full moon and why. Where does the new moon rise and where does it set? Does moon rise earlier or later on succeeding nights? How does the moon give light? Discuss various phases of the moon.

Seasons and rainfall.—Review all previous work with reference to change of seasons; causes of rain, value of rain. What are snow and ice and how caused?

Physical phenomena.—Burning of wood and coal; kerosene lamp; evaporation of water; wind as a drying agency on mud, etc.; cloudy days and nights contrasted with clear days and nights. Frost and its effects upon plant life; insect life. Effect of cold weather upon children.

Brook and soil.—Review all previous instruction regarding the work of the brook and how soil is made.

IV. OUTLINES FOR THE FOURTH GRADE

1. HUMAN NEEDS, INTERESTS, AND ACTIVITIES

Seasonal activities.—Review in general as given in previous grades. Take some one field crop as barley, wheat, or alfalfa and make a detailed study of processes and operations in raising the crop from the preparation of the soil to the final marketing of the crop.

Seasonal needs.—Review in general as given in previous grades. Take some one need, as clothing, or shelter, and have children find out just how this need may be supplied—factors, materials, labor, etc.



Social interests.—The year's recreation activities. Plans and programs. Social and educational values. Games and play on the school grounds. Participation of children and relation of experiences. What institutions in the community are helping to give a richer social content to neighborhood life.

Health needs.—Hygiene for the school and home and community. Personal responsibility of pupils. Refer to some good elementary text on physiology for material and rules for the promotion of good health. Good and bad teeth and their relation to health. Structure and care of the teeth. Use of teeth. Use of the toothbrush. Work of the dentist. Muscles, uses, movements, etc. Bones and their relation to muscles. Good positions of the body. Value of good habits in posture of body while young. Value and necessity of exercise. A health reader on the above topics may be used in class. Do good, thorough work in this connection.

2. PLANT LIFE THROUGHOUT THE YEAR

Garden studies.—This is a necessary topic for every grade. Review studies of previous grades and get a new point of view of some more or less familiar phases of garden interest. How does the garden compare with previous years? What things of special interest during this year? Plans for home and school gardens. Study of seed catalogues. Mistakes made last year and measures to avoid them this year. Grow several varieties of radish and lettuce to determine the most desirable. Make out a list of vegetables to be planted for the school exhibit.

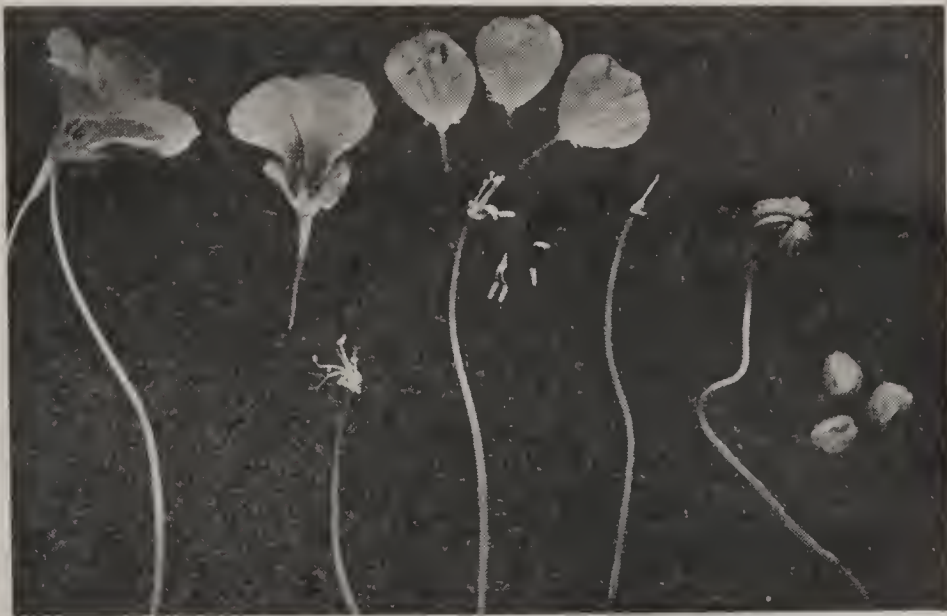
Sweet Corn.—Examine seed. Discuss preparation of soil and best time to plant. Watch growth and report when tassel appears; when the silk appears; height of stem, thickness, size of leaves, etc. Number of ears on stalk. Compare with pop corn or field corn, if any is grown in the district. Uses of sweet corn. Why used as human food? Discuss canning of sweet corn. Tell all the things that must be done from the time the kernels are planted to the time when the cans are shipped away. Damage done by the corn ear worm.

Sunflower.—Study entire plant as it is growing. Have pupils tell all they see. Go into details as to height, color, character of stem, leaf, flower. Look carefully at sunflower head at different stages of growth. Is the flower one or many? A small flower is called what? Each produces what? How many seeds in a head? Color and various uses of seeds? Where on the head do the seeds ripen first? Watch the bees on the sunflower head. What do they want and what are they doing?

Bulbs.—Have a bulb garden on the school ground, if possible. Consult seed catalogue as to best time and methods of setting bulbs out. Tulips, narcissus, daffodils, and crocuses are good. Who in the community has been especially successful in bulb gardening at home? Have children find out how success was obtained. Factors in success as proper location of bulb bed; character of soil; preparation of soil; use of well rotted manure; depth of planting, etc. The indoor bulb garden. Bulbs planted in boxes, pots or tin cans for blooming.

Nasturtium.—Study of flower, stem, leaves, and seed. Teach calyx—number of parts, peculiarities, etc.; corolla—number of petals, markings, nectar guides, and spur; shape of lower petals, etc. Position of stamens when flower first opens. Length of filaments. Number of stamens. Anther or pollen boxes. How many open at a time? The pistil and stigma. Where is the seed box?

Changes in its appearance. Number of seeds. Color, etc. Pupils should be interested to study blossoms of the nasturtium at home to see how the insects carry pollen from one flower to another. Notice the special arrangement of the pistil and stamens to encourage cross-



pollination. How do the flowers stand on the stem? Why? Study of characteristics of stem and leaves. How does the stem manage to climb? Interesting facts about the nasturtium. Why a favorite about the home?



Onion.—Have children bring into the schoolroom a few large onions. What is an onion? Examine both ends and discuss appearance. Outside covering of onion. What is its use? Cut onion open and notice layers. What are they? Testing of onion seed. Notice parts of seeds when germinated. Watch growth and report. Growing

onions in the garden. Kind of soil needed, preparation of the seed bed. Various ways of growing onions. Onions for summer use; for winter use. Cultivation of onions. Study catalogue for culture hints and commercial importance of the onion crop.

Wild flowers.—Review in a general way the studies given in previous grades. Make a special study of the California Poppy. Study parts as in case of the nasturtium. Kind of root, stem, leaves, flower, bud, blossom, parts of seed, pod, etc. Why a favorite flower? Have children discuss why wild flowers can send up blossoms so early in the spring or after the rainy season has opened.



Weeds.—What is a weed? Ways in which weeds are an injury. What are the common weeds of the community? See list on another page. Take one very common weed and find out about its root, whether a deep-boring tap root; or a tassel-like root of many fibers also boring deep; or a spreading, many-branched but shallow-growing; or a creeping root-stock with underground buds. Stem round, angled, or grooved? Solid or hollow? Rough or smooth? Hairy or woolly? Any spines? Strong or weak? What other peculiarities of stem? Describe leaves. How arranged on a stalk? Are leaves smooth or rough? Character of edges? When does the weed begin to blossom? What kind of blossom has it? Describe the parts of the flower. How is the pollen carried from flower to flower, by insects or the wind? How do the seeds ripen, all at once or in succession? Many seeds or few? How scattered? What is an annual weed? A biennial? A perennial? Illustrations of each.

Maple tree.—Trunk smooth or rough, branches many or few, color of branches and trunk? How are the branches arranged, spread out or growing upward? Few or many twigs, straight or crooked? Shape of tree, round or wide at bottom and pointed at top like a pyramid,

or shaped like an umbrella. On the twigs look for buds, scars, and rings. How are buds arranged, opposite or alternate? Is there one at the end of the twig? What will this become? What will the side bud become? Watch growth of tree for answers. Watch for flowers of the maple. Distinguish between flowers that have stamens and those that have pistils which develop into fruit and seeds. After the flowers have disappeared watch the development of seeds. How do the seeds get away from the parent tree?



Autumn Festival.—Plans for exhibition of best fruits of field, garden, and orchard in the schoolhouse. Review general directions given in previous grades. Appoint committees before school closes in the spring. Endeavor to enlist the coöperation of the patrons.

3. ANIMAL LIFE THROUGHOUT THE YEAR

Insect life.—For help in insect study throughout the grades consult Essig's *Injurious and Beneficial Insects of California*. See list on other pages. Also get help from the county horticulturist. Over forty counties now have such an officer. For this grade select one insect injurious to orchards, grapes, and berries, garden, forage crops, and ornamental plants. For illustration the *Western Twelve-Spotted Cucumber Beetle* (Essig, page 270). Watch for this insect in the garden. Describe its appearance. How easily recognized? Size. Search for its eggs. Appearance of the larvae. What is the life history of this beetle? How does it work? Where found? What plants does it eat? How control this pest? Give the spray formula. What natural enemies does it have?

Home-making insects.—Bees, wasps, ants, etc. Make a detailed study of the honey bee. Watch the bees at work gathering pollen and nectar from the flowers. If possible watch them at work in the hive. Classes of bees. Life history. Care of bees.

The house fly.—Kinds. The common house fly is black in color with five parallel, more or less distinct grayish bands on the back between the wings. Number of wings? Body and legs covered with what? Length of life of the fly? Breeding places of flies. Danger to health. How eradicate flies?



Spiders.—How differ from insects proper? Where are spiders found? What time of the year? Four general classes, web weaver, crab spiders, running spiders, jumping spiders. Endeavor to study one of each class. Look for webs. How many kinds? Names of spiders with reference to kind of webs—cobweb weavers, funnel web weavers, filmy dome weaver, orb weaver. What is the difference in the appearance of these webs? Try to observe a spider at work spinning its web. Use of the web? Food of spiders. Items of interest about the web. Where are the spinnerets?

Bird life.—From list of California birds given on another page select three or four for detailed study, noting size, colors whether bright or dull; special markings on head, back, breast, wings, or tail; general shape of body, whether long and slender or short and stocky; character of bill, short, long curved, hooked; wings short and round

or long and slender; tail forked, notched, square, fan-shaped; movements, hop, walk, creeping up trees, motions of body in various situations; manner of flight, steady, direct, rig-zag, quick or slow flapping, sailing, etc. Places where the particular birds are found, fields, around the house, gardens, hedges, streams, etc. Food, and how procured; character of song and call notes.

Wild mammals.—See list on another page. What is meant by wild mammals? What is meant by domestic or tame mammals? Name several of each class. Select a common wild mammal in the district and make a detailed study as to appearance; chief characteristics; habits; food; damage to crops; damage to trees; plants that it does not eat; natural enemies; methods of control by man.

Barnyard fowls.—Different varieties or kinds of chickens, ducks, geese, turkeys.

The Turkey.—Special study. Difference in appearance of the male and female birds. Covering of the head of the turkey? Color and how far down the neck? What is the “wattle”? What is the “caruncle”? What are “the beads” on the neck? Color of the eyes? Where is the ear? Can a turkey hear well? Do turkeys scratch like hens? Describe feet and legs as to shape, size, and color. Where do turkeys like to roost? Are they sound sleepers? Where do turkeys thrive best? What is their food? Why study the turkey in the month of November? How do turkeys fight? How does a “Gobbler” strut? How early in the spring does the turkey hen begin to lay her eggs? Describe the nesting place and the turkey hen’s attitude towards visitors to the nest. How many eggs in the nest? Describe the eggs. Care necessary for the young turkeys. Are there any wild turkeys in the vicinity? Is turkey raising profitable?

4. PHYSICAL PHENOMENA AND THE INORGANIC WORLD

Rain.—How caused? Inches of rainfall during the past year? Average rainfall for the locality. Forms of water, ice, steam, solid ice, liquid water, gaseous steam. *Snow, Hail, Frost, Dew.* Explain each.

Distinction between “soft” water and “hard” water. Storing of ice. Manufacture of ice. Cold storage and use of refrigerators. Storage of water. Making of ice cream.

Thermometer.—Explain construction and use. Keep a daily temperature calendar for thirty days. Compute the average daily temperature.

The Sun.—Time of sunrise and sunset. The longest day in the year. The shortest. What is meant by “the sun crossing the line”? Meaning of equinoxes? Solstices? How long does it take the light of the sun to reach the earth? How many days of cloudless sunshine in one week? In one month?

V. OUTLINES FOR THE FIFTH GRADE

1. HUMAN NEEDS, INTERESTS, AND ACTIVITIES

Vacation activities.—Reports on condition of home gardens. What garden crops have been harvested? What are soon to be ready for harvesting? Discussion of special things in connection with vacation work in the gardens. Preliminary report on proposed agricultural exhibit in the school. Work of various committees.



Farm interests.—Survey of present crop conditions in the community. How many acres of wheat, barley, etc., have been harvested? What is the importance of the livestock interests? Are there any pure bred herds of dairy cattle? Have children gather data at home of a general agricultural interest and report.

Seasonal activities.—Describe the cutting of alfalfa, wheat, corn, etc. Special items of interest in connection with the orchard pruning; the best time for pruning and spraying. Consult the county horticulturist or the farm advisor for information as to latest phases of orchard management, crop operations, livestock, etc. If possible have children get topics for discussion at some farm bureau meeting. Insist that the school keep in touch with progressive agriculture in the community. Discuss best methods of preparation of seed bed for various crops.

Human needs.—Make a list of the principal social, educational, and recreational needs of the people of the community, What attempts are made to satisfy these needs? What is the farm bureau doing to satisfy economic or social needs of the farmer? Do farmers need money to develop their business? Is the church or the home making any special effort to satisfy wants and need? In what way? What is the school planning for the year? Modern conveniences in the home. What do they cost? What is a sanitary home? How is the house cleaned? What devices may lighten labor? Find out what is being introduced into the homes of the community? How is the farmer's work made easier? Labor saving tools on the farm.

Health needs.—It will be necessary, of course, during the year to review some of the previous years' work in physiology and hygiene. This year the emphasis may be placed on food and the digestive system, and respiration and the organs of respiration. Any good elementary text or health primer may be used as a reader to supplement the regular reading material and furnish abundant topics for discussion. Plan to observe health day with a special program. How prevent diseases? Character of disinfectants. Care of the school drinking cups and the water jar. Value of good sunlight with reference to health. Condition of the outbuildings. Character of water supply in the community.

2. PLANT LIFE THROUGHOUT THE YEAR

Strawberry.—Reports on strawberry crop of the district. Are any grown for other than home use? Make list of questions for study of the strawberry plant, the children doing their observation work at home. Have one plant with runners in the schoolroom when children make their reports. Verify the statements of children. What is peculiar about the blossoms of the strawberry plant? When set out strawberry plants? How are they set out? How cultivated? Do the plants die during the winter? What name is given to plants that live from year to year? In severe winters why are the strawberry plants covered? What is meant by the mulching of plants? What material may be used for mulching? Does the entire plant live over winter?

Biennials.—Beet or turnip as a type. Each child bring a few beet seeds to school. Where did they get the beet seed? Has any one ever seen the beet in blossom? Get a good plump beet and plant it in a box. At the same time plant a few of the beet seed. In time the children will see that plants come from the beet root as well as from

the seed. With the seed growing into plants and plants growing from the beet root throughout the season one may learn the life history of a beet. It takes two years for certain plants like the beet to go through all stages of life from seed to seed. Such a plant is called a biennial. Other biennials are turnips, cabbage, parsnips, carrot salsify, etc.

Lawn grass.—Name different kinds of plants used in making a lawn—Kentucky blue grass, white clover, Australian rye grass, Bermuda grass, Lippia, etc. Dig up a small bunch, wash soil out, carefully note character of root growth. Notice small fibers and main



root stock. Value of root stock during the dry season or winter. When rains begin what is the effect? Ways of starting some lawn grasses by seed and sod.

Dandelion.—Notice plant in various stages of growth. Does it live through the winter? Biennial or perennial? Notice arrangement of leaves on plant just appearing above the surface of the ground. Where are the oldest leaves? The youngest? Dig up plants and get entire root. Compare it with roots of blue grass or some other plant. Advantage of the long fleshy tap root? Compare with the California Poppy in this respect. Pull the rosette or cluster of leaves apart and notice tiny flower buds. Study flower of the dandelion at different stages of growth, position, length of stem, etc. When does the flower close? Is the flower a single or cluster? Compare with other flowers studied.

Weeds.—From list given on another page, select one, as the *Wild Radish* for example, and make a detailed study, using directions for

studying the dandelion and directions given in previous grades. Contrast appearance, manner of growth, character of stem, leaves, flowers, seed, and root of the wild radish with the dandelion or wild morning glory or milkweed or thistle. In this grade teach children to recognize three new weeds and study their manner of growth and means of eradication.

Cultivated flowers.—From list on another page select one flower for study, as the fuschia. Something about its early history, original varieties, colors. Character of stem. Shape of leaves, thickness, etc. Parts of the flower—tubular corolla, number of parts united; calyx



with number of sepals; number of stamens and how attached; the pistil with reference to position of stamens. Is the fuschia a self-pollinated flower or is it dependent upon insects? Where is the nectary and what kind of insects can get at the nectar? Watch a flower to find out. Describe the seed pod. Count the number of seeds. Value of the fuschia as an ornamental plant.

Cultivated vegetables.—Select one as the *turnip* for illustration and make a detailed study somewhat after the manner of studying the beet and tomato given above. Emphasize the food value and manner of growing—preparation of seed bed, cultivation, enemies, harvest and storing, methods of cooking, etc.

3. ANIMAL LIFE THROUGHOUT THE YEAR

The Pig.—General characteristics. Comparison of nose with nose of other farm animals. Why does it root? Describe its teeth, eyes, head. Does the pig have much intelligence? How are the ears placed on the head? How is its body covered? Habits, and why considered a dirty animal? Natural food of the hog. What is fed to the hog on

the farm? Describe the pig's foot. How many toes? How many used in walking? Can the pig swim? What noises made by the pig? Name and describe the principal breeds of pigs. History of hogs (see Davenport's *Domesticated Animals and Plants*).

The Colt.—How old before it can run? What is the weight of a colt one week old? What care should a young colt receive? How teach him to lead? Importance of right training. Food of colt other than mother's milk. When are colts weaned? What kind of pasture is good for a young colt?



The Dog.—Origin. Why equipped with stronger legs than the cat? How do the claws of a dog differ from those of a cat? Describe a dog's feet. How many toes? Describe the dog's body. With what is it covered? What is the shape and color of a dog's eyes? Can the dog see in the dark? What about his ability to see and hear? What one of the five senses is most highly developed? Describe his teeth. For what different purposes are they used? How does a dog express his emotions? What noises does a dog make? Why does a dog bay at the moon or howl when he hears music? Name the different breeds of dogs. What leads to the development of these different breeds? What is the best dog for the farm?

The Mouse.—What good things can be said of the mouse? Where does the mouse live? What kind of a home does it have? What is its food? What damage does it do? How does the field mouse differ from the house mouse? Identify and study the *deer mouse* and *meadow mouse* described on another page. What enemies does the mouse have? What is the most humane way of getting rid of mice?

Fish.—Importance of fishing industry. If possible have a small fish in a large bowl of water in the schoolroom. From observation here or of fish in the stream have children try to determine how a fish moves through the water; fins used most; number of fins; how it

eats and breathes. Can it see, smell, and hear? From a visit or from reading describe a fish hatchery. Value of fish as food. Kinds of fish. Any laws for the protection of fish? What are they? Accounts of a fishing trip.

Birds.—List of birds identified on the blackboard. Keep bird calendar. Make special study of seed-eating birds. Study Western Meadow Lark, Song Sparrow, White-Crowned Sparrow, Green-Backed Goldfinch, California Towhee. See other pages.

Moth and Butterfly.—Four different forms during life, viz., eggs, larva, pupa, adult. Look for eggs in clusters or single, usually found on plant which is favorite food of young. The larva is the worm which hatches from the egg. This is the stage when the eating and



growing is done. Pupa is the period when it rests or sleeps and wonderful changes take place. The adult is the fullgrown insect. Difference between butterflies and moths: (a) body—moth is stout, butterfly is slender; (b) wings—moth has wings folded flat along back when at rest; (c) antennae—moth are threadlike or feathery, but never knobbed at the apex, butterfly has knobs at end of antennae; (d) flight—the moth flies at night, the butterfly flies by day; (e) pupa—moth has pupa protected either inside cocoons or by being underground or in some sheltered place, butterfly has a naked pupa attached by the tail end to a button of silk.

Cabbage Butterfly and Worm.—(Essig, *Injurious and Beneficial Insects of California*, pp. 455–457.) Watch for butterfly in garden hovering over the cabbages. Describe appearance. How tell the male from the female? Size and color of eggs? Appearance of the worm; the chrysalis, find out. Life history of this garden pest. Nature of work of the caterpillars or worms. Damage to cabbage. What other plants does the worm feed upon? Control both by spraying and otherwise.

The devastating Grasshopper.—Where are grasshoppers found? Watch movements. How many wings? Legs? Sizes of legs. Notice how under wings are folded. Use of outer wings. Watch movement

of mouth when grasshopper is eating. Carefully dissect the mouth, showing all the parts. Names of the parts. (See Comstock's *Handbook of Nature Study for Teachers*—an invaluable help.) Look on the head of the grasshopper for its eyes. How many? Describe the feelers or antennae. They are the organs of touch. Raise the wings and find the ears of the grasshopper. How many? How does the grasshopper make its music? Various kinds of grasshoppers. Describe the devastating grasshopper; color, spots on hind legs, wings, etc. Life history. How different from life history of the cabbage butterfly? Food plants of this grasshopper. Method of control.

Mosquitoes.—(See Bulletin No. 178, "Mosquito Control," College of Agriculture, Berkeley.) What do children know already about the mosquito and its habits? When are mosquitoes most active? When and where do they rest? What do they eat? Most live largely upon juices of plants as they do not have a chance to suck the blood of animals. Only the females bite. Discuss life history. Breeding places; eggs, larvae or wiggle tails? How long does it take for the eggs to hatch? Position of larvae in water. Larvae of malarial mosquitoes almost parallel with surface of the water. Larvae of common mosquito beneath surface of water at an angle of about forty-five degrees. How does the larvae breathe? Change of larvae to pupae. Description. Do the pupae move as did the larvae? How does the pupae breathe? Does it eat anything? Watch for the pupae skins from which have emerged the adult mosquito. Methods of control. See also Farmer's Bulletins No. 155, U. S. Dept. of Agriculture, on "How Insects Affect the Health in Rural Districts."

4. PHYSICAL PHENOMENA AND THE INORGANIC WORLD

Heat.—Chief source, Nature. How heat produces light. Difference between heat and light. Discussion of primitive fire-making. Modern way. Various ways of producing heat—friction, combustion, etc. Ways in which heat may be transmitted. Explanation of conductor and non-conductor. Application to kinds of clothing, weight, material, color, etc. Meaning of fireproof buildings. First aid for a severe burn. Meaning of "spontaneous combustion." Illustrations of action of heat in common affairs of life, as pouring hot water into a glass dish.

Crystals.—Illustrations in nature. Examine ice and snow; surface of freshly broken rocks or minerals. How make crystals with common salt or with alum? Blue vitrol is a poison yet it makes fine crystals. What is rock candy? What precious stones are crystals?

Rocks.—How formed? Explain granite, lava, slate, sandstone, limestone. Have specimens in the schoolroom for a discussion on the origin of soil. Relation of rocks to the earth's crust. What is sedimentary rock? Look at small stones along the edge of a stream or in the dry bed. What are the various shapes? What has caused the changes? What are the fossils sometimes found in rocks? What forces cause the decay of rocks? What are some of the common minerals found in rocks?

Air.—Different elements that compose the air. How deep or thick is the layer of air surrounding the earth? How heavy is the air or what is its pressure? Why do we not feel this pressure? What do we mean by the temperature of the atmosphere? How do we measure it? Why does the air get colder as we go up? What causes winds? Necessity of air for animals and plants. Air in soil and water. How is air made impure? Explain how carbon dioxide is made. What relation does oxygen have to combustion? How is nitrogen valuable to plant life? If the atmosphere at sea level weighs fifteen pounds to the square inch, and if four-fifths of this weight is nitrogen, how many pounds of nitrogen are pressing down on every acre of the earth's surface?

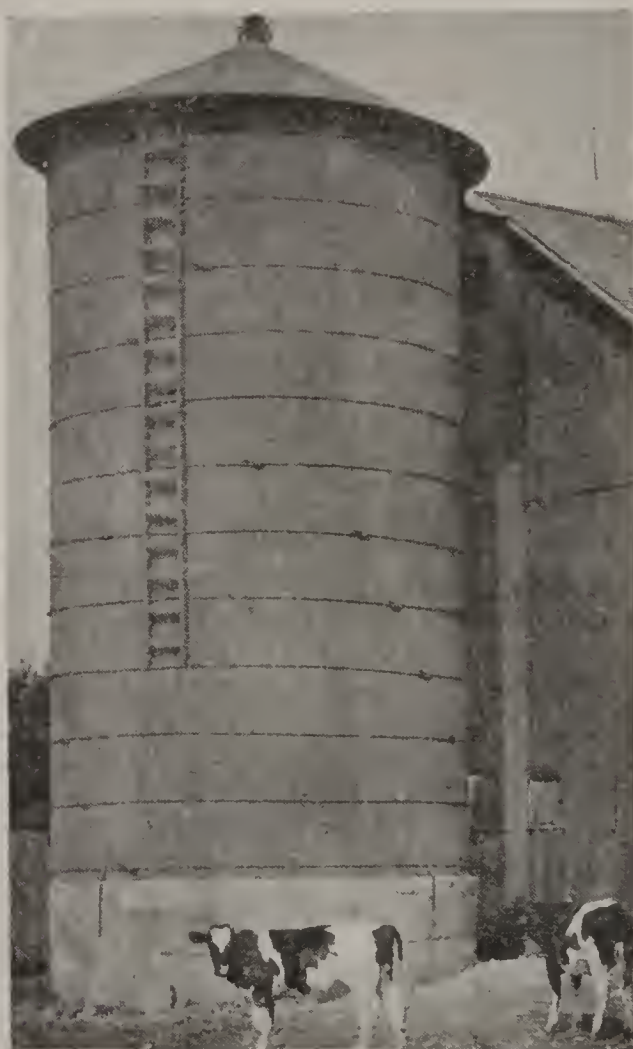
VI. OUTLINES FOR THE SIXTH GRADE

1. HUMAN NEEDS, INTERESTS, AND ACTIVITIES

Silo construction.—Number of silos in the community. Any in the process of construction? Children get data as to materials used, wood, concrete, brick, stone, or steel. Method of construction. Size and shape of a silo. Children estimate the volume of a silo in pounds. Find out how many pounds of silage are fed daily to a cow. Estimate how long the silage in this particular silo would last for a herd of ten cows. Advantages of a silo. See Circular 138 of the College of Agriculture at Berkeley on "The Silo in California Agriculture," by F. W. Woll.

Correspondence courses in agriculture.—Through the pupils of the school make an agricultural education survey of the district to ascertain how many are enrolled in the correspondence courses of the Division of Agricultural Education of the University of California. Send for Circular 113, which describes the character of these courses. Many of these courses will prove of value to the teacher in the work of the seventh and the eighth grades.

Special irrigation problems.—Very valuable material for many rural schools in Bulletin 253 of the College of Agriculture at Berkeley entitled “Irrigation and Soil Conditions in the Sierra Nevada Foothills of California.” Well illustrated with photographs and diagrams. Text to be studied by the teacher and a series of questions placed on the blackboard, the answers to which will be brought in by the children after observation and study of irrigation practices and soil conditions of the school district. This is a most important topic under human needs and interest in California agriculture.



Marketing grain.—Methods of storing wheat, barley, etc. Changes in shipping conditions. The sack versus the bulk method. Items of cost in harvesting and shipping. See Circular No. 152 of the College of Agriculture at Berkeley entitled “Some Observations on the Bulk Handling of Grain for California.” Teacher make out list of questions for children to investigate at home. The bulletins mentioned above are not to be put in the hands of pupils. They furnish material for the teacher to emphasize in this grade and the two upper grades, more the economic phase of agricultural nature study.

Recreational needs.—Discussion of social activities of the neighborhood. Reports on community fairs, play festivals, picnics, fishing

excursions, etc. How can the schoolhouse be made the social and recreation center? Spirit and practical application of the California law in this regard.

Health and sanitation.—General health of the community. Any epidemics because of contagious diseases or bad sanitary conditions? Drainage and water supply of the community. From an elementary text book on physiology and hygiene make a special study of the eye. Parts of the eye. Muscles, glands, etc. Kind of light best for reading. Effect of bad light. Weak eyesight and the need of glasses. How test the eye for deficiencies in sight? Supreme importance of guard-



ing the eyesight of children. Character of light in the schoolroom. Special study of circulation and the organs of circulation. The blood, composition, etc. Keeping the blood pure. Dangers of diseases entering the body through the blood by infection. Sanitary importance of cleanliness. Individual drinking cups, the sanitary earthen water jar or the bubbling fountain. The skin, structure and office of regulating the temperature of the body. Glands of the skin. Care of the skin. Appendages of the skin, as hair and nails. Importance and care. Review foods and digestion.

2. PLANT LIFE THROUGHOUT THE YEAR

Geranium cuttings.—As soon as the rainy season opens well enough to prepare the soil, plant some cuttings. Discussion of the part of the geranium to plant—old stem or new growth? Show how to prepare the cutting before placing it in the earth. Put some of the cuttings or “slips” in a box of sand in the schoolroom, where a better

control may be had. Show how to place the cuttings in the sand. Discuss favorable conditions for growth as to moisture, light, temperature. Transplant to open ground when cuttings are well rooted. Teach children how to transplant. After transplanting watch for new leaves. Children bring flower pots to school for cuttings to take home. Discussion of proper soil, drainage, etc., for the potted plant. Teach children how to pot a plant properly. Consult some experienced gardener or housewife who has been successful.

Grape cuttings.—Consult someone with experience, either the county horticulturist or a successful grower of grapes, to find out (a) are cuttings employed very much to start new vineyards? If not, what ways are employed? (b) if so, when is the best time to make the cuttings? (c) from what wood or cane is the cutting made? (d) how many buds on a cutting and how arranged? (e) how is a cutting made? (f) when place the cuttings in soil or sand? (g) how long does it take for a “callus” to form? (h) when are the cuttings transplanted? (i) method of permanent planting. Care of the vineyard. Methods of pruning employed.

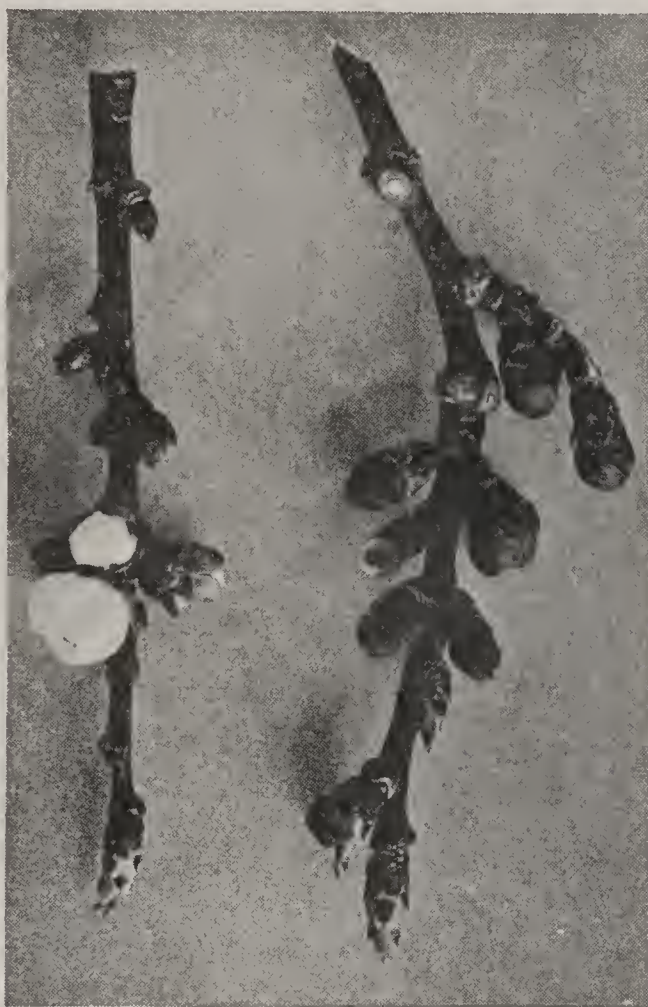
Grafting.—Find out the various practices among orchardists in the district. What guiding principle or principles in grafting? Common example of English Walnut upon native black walnut stock. Have school report all other examples. Best time to graft. Best method of grafting. Advantages of grafting.

Budding.—Meaning? To what extent practiced in the community? When to bud? Discuss method of budding. Advantages.

Demonstration of propagation.—If possible make arrangements with the county horticulturist, the farm adviser, or a successful local gardener or fruit grower to visit your school on some Friday afternoon and give a practical demonstration before the children of all the best ways of plant propagation. This need not be limited to the sixth grade, but should be done before the entire school.

Fruit blossoms.—Study blossoms of all common fruit trees in the neighborhood. Shape of bud. Where placed on the twig? Describe bud and bud scales. What changes as bud expands in the bud scales? Do leaves and flowers come from the same bud? Difference between leaf bud and fruit bud? On what growth of wood are flower buds borne? What are the scars seen on twigs? Notice a bud ready to open. Length of its stem. Describe calyx. Are sepals entirely separate or joined. Where united? Number of sepals. Describe the open blossom. Number, shape, and color of petals. How attached? Number of stamens. How attached to the flower? Length of stamens?

color of anthers, pollen and filaments. Number of pistils. Describe the stigma, color, and position with reference to anthers. Do fruit blossoms close at night? Any insects about the blossoms? Their importance. When petals fall, what is left? What part of the flower develops into the fruit? What happens to the sepals or calyx? When is the best time to spray the blossoms? Study the buds and blossoms of the apple as a type and then compare in all points with blossoms of the peach, cherry, prune, pear, plum, apricot.



Study of the apple.—Shape in different varieties. Are any two apples of the same variety exactly alike? General characteristics of a particular variety as to shape; color markings of the skin; character of skin, whether tough or delicate, etc. Value of the skin. Why care in packing for shipping? Notice carefully the stem end and blossom end of the apple. What are the withered points at the blossom end of the apple? Position in different varieties of apples? Cut open an apple. Notice texture of the fleshy part. Locate and describe carpels. Cut an apple across midway between stem end and blossom end and note the five-pointed star. What found here? Describe the apple seed. In either portion of the apple thus cut across locate the “core line.” Identify the bundles of fibers extending through the center of the apple from stem to basin. How many? Identify the second

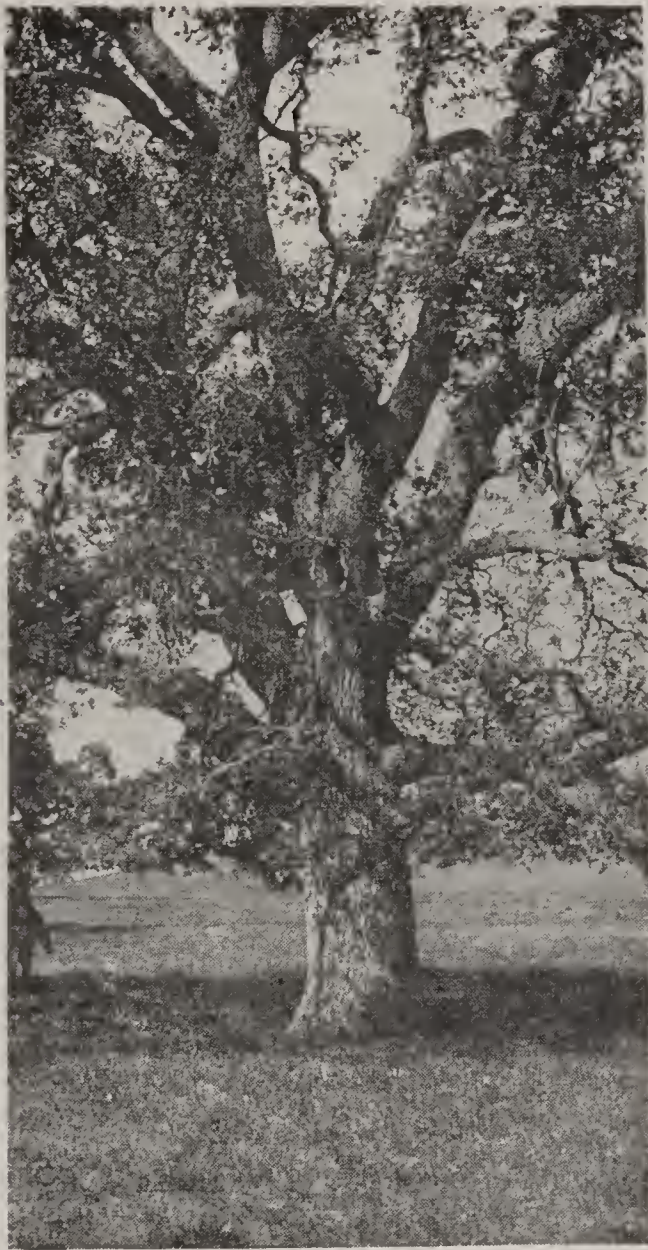
“core line” in the cut-open apple. Can you see ten faint dots in the cross section of the apple? What are these dots? Discussion of the value of apples as food. Various ways of cooking. Methods of storing and marketing. Different varieties of apples grown in the neighborhood.

The Potato.—Make a brief potato survey of the community to ascertain the importance of this particular crop locally. Any grown on a large scale commercially? Number of acres? Number of bags sold last year? Price per bag. Shipped away when dug? Any stored and methods of storage. Does each family grow enough for



food? Bring a few potatoes to school, varieties of each kind grown in the district. Study variety types and characteristics. Is the potato a seed? If not, what is it? Why say “seed” potatoes? Discuss the “eyes” of the potato. How is the potato a part of the stem? If so, where are the buds? Cut a potato in two through one of the “eyes.” Describe and sketch cross-section. Compare with cross-section of a thick branch of a tree. Make the iodine test for starch of the potato. Put two or three potatoes in a box of sand, moisten properly, keep in proper temperature and light, and direct children to record daily observations. Plant the whole potato or cut it in pieces? Practices of potato growers of the community. Have children make observations of the best methods of preparing the seed bed for potato planting. Discussion in class. Rotation of crops valuable for the potato patch. Why? How plant potatoes? Insist on careful statement of all details. Various methods of cultivation observed and

reported on. Arrange that each child large enough may have a few choice potatoes for seed and start a potato growing contest at home, the best of the yield to be exhibited at the school fair. Each pupil keep a careful record of this home project in potato growing, viz., size of plot, number of potatoes planted, the variety, method of preparing the soil, when and how planted. Dates when plants first appeared above the ground; when the tubers were big enough for use;



when potatoes were finally dug. Special treatment for insect pests or diseases. With class study the potato flower; color and position on the stem; color of flowers of different varieties. Any other plants have flowers similar to the potato flower? Compare with the tomato flower. Discuss the formalin treatment for potato scab.

Weeds.—Why successful plants? Make lists of weeds according to place where they grow: (a) garden; (b) cultivated fields; (c) pasture; (d) lawn and vacant lots; (e) roadside. Group these same weeds on other pages as to manner of life into (a) annuals; (b)

biennials; (c) perennials. Select three weeds not studied thus far, and discuss environment as to soil, moisture, climate, relation to other plants, etc. Recognition of weeds. General form of plant. Characteristics of stem, leaves, root, flower, seeds, habits of growth, and manner of seed dispersal. Methods of eradication. See Shaw's *Weeds and How to Eradicate Them*; Weed's *Farm Friends and Farm Foes*, Part I; Farmers' Bulletin No. 188, "Weeds Used in Medicine"; No. 279, "A Method of Eradicating Johnson Grass"; No. 660, "Weeds and How to Control Them." (List of Fifty Worst Weeds.)



Trees.—Study of trees in the vicinity of the school? Bring twigs into schoolroom and study buds, leaf scars, rings of growth, etc. Sketch twigs showing everything. Describe the different parts of a tree. Comparison of parts in different trees. How recognize trees by shape of leaf and color of bark? How do trees reproduce their kind? How do trees breathe? How do trees grow? How do trees feed? Best methods of planting trees. Value of trees. Trees and forestry. The spirit of forestry. Value of the small woodlot at home. See Jepson's *Trees of California*; Comstock's *Handbook of Nature Study for Teachers*, and Roger's *Among Green Trees*.

Garden work.—Plan for the home vegetable and flower garden. Study seed catalogues. Discuss what to plant in the way of annuals and biennials.

Fall Festival.—Make necessary plans for the annual school fair and harvest home festival. Study artistic arrangement of fruits, vegetables, and flowers.

3. ANIMAL LIFE THROUGHOUT THE YEAR

Insects.—(Reference, Essig's *Injurious and Beneficial Insects of California*.)

Codling-Moth.—(Essig, pp. 436–438.) Study in connection with the apple. Description of eggs, larvae, etc. Life history. Nature of work. Food. Control. When to spray, etc. Children make observations in orchards and report.

Other insects.—In like manner study San Jose scale (Essig, pp. 179, 180); Walnut Aphis (Essig, pp. 82, 83); Squash bug (Essig, pp. 202, 203); Potato tuber moth (Essig, pp. 446, 447); see also Monthly Bulletins of the State Horticultural Commission.

Birds.—As tree protectors. Select for study those birds that especially feed on insects, as Red-shafted Flicker or Yellowhammer, California Woodpecker, Western Meadowlark, Bullock Oriole, Black-headed Grosbeak, Western Warbling Vireo, California Bush-tit, Western Blue-bird. Classify birds as to permanent residents, summer residents, winter residents, migrants. See other pages for description.

Geese.—General appearance. Chief differences between a goose and a duck as to bill, length of neck, legs, wings, walk, flight. Examine track of goose. How different from track of the duck? When are geese "picked"? Why? Describe in shape and color the Toulouse, the Embden, the African, and the Chinese geese. How many found in the school district? Describe food of geese; nest and eggs. What name given to the young of geese? Describe in general appearance and covering. How do the old take care of their young? How does a goose fight? What care does a goose take of her body? Stories of geese as to their intelligence, etc.

Sheep.—Any in the district? What kinds? Are they "mutton" or "wool" sheep? Meaning of terms. Study habits of sheep. Describe the mouth? How many and what kinds of teeth? How can the sheep eat the grass so closely? Are sheep allowed in forest reservations? Why not? Enemies of the sheep. How does a sheep fight? Hearing and seeing of the sheep. Describe a young lamb. Name the principal breeds of sheep? What are the chief things that distinguish a sheep from other animals? What are the chief qualities of a good shepherd and his dog? Where was the original home of the sheep? How does a sheep differ from a goat?

Wild mammals.—Study habits of California mole; California coon; California skunk; California pocket gopher. Consult Comstock's *Handbook of Nature Study for Teachers* for valuable suggestions and

practical helps. Write to College of Agriculture and U. S. Department of Agriculture for bulletins. Above all else, set the children to watching these animals to discover their manner of life.

4. PHYSICAL PHENOMENA AND THE INORGANIC WORLD

Weather.—Work of the weather bureau of the U. S. Department of Agriculture in relation to farm interests. Weather maps. Get copies for several successive days and with a wall map of the United States learn how to read the weather map. Meanings of areas of high pressure and low pressure. What do the arrows on the map indicate? Meaning of isobars. The movement of a storm. Character of clouds, winds, and changes of the barometer and thermometer.



Barometer.—Study in connection with weather map, etc. How is a barometer made? Use of mercury. How high is the column of mercury at the sea level? What is the pressure of air at this point? How is the barometer useful in measuring the heights of mountains, etc. Actions of the barometer to indicate fair or foul weather. Review the thermometer.

Light.—Meaning of the term “self-luminous.” Give illustrations of self-luminous bodies in nature. What is a “luminous” object? Give illustrations. How do light-rays travel? Which travels the faster, light or sound? Give proof of your answer. What is the velocity of light per second? Of sound? How long does it take light from the sun to reach the earth? How long does it take to reach the earth from the nearest fixed star? Why does a spoon appear broken when placed in a tumbler half-full of water? Why can we see ourselves in a

mirror? Meaning of diffused light and why it is best for our eyes? What is the sundial?

The brook.—Study of a small stream and its work. Beginning and end of this particular brook. Character of course and why. Character of its banks at various places. Difference in open country from wooded region. Meaning of the “work” of a brook. With what tools does it work? When does a brook “play”? Causes of difference of color of water at various times. Fill a fruit jar with the muddy water of a brook and allow to settle. What is the result? Look at the pebbles in a brook and along its banks. What do you find? Why are some very smooth? Explain sedimentation and erosion from study of the work of a brook. Find a delta. See Miller’s *The Brook Book* and Frye’s *Brooks and Brook Basins*.

Soil.—Surface of earth covered with rock. Agents that helped to break up the rock crust. Work of glaciers, water, winds, air, etc. Expansion and contraction through heat and cold. Samples of sand, gravel, small pebbles, clay, and garden soil in the schoolroom. Explanation of humus. Action of bacteria. See Fletcher’s *Soils* for the story of the formation of the soil.

VII. OUTLINES FOR THE SEVENTH GRADE

[See especially printed outlines on the School Garden and the Home Garden and Vegetable Growing Project for material for the Seventh and the Eighth grades.] See reference on page 1.

1. HUMAN NEEDS, INTERESTS, AND ACTIVITIES

Vacation activities.—Reports from pupils as to the home garden projects.

Calendar of farm operations.—Discuss methods of keeping an account of the farm operations by months during the coming school year. Enumerate the principal agricultural activities of the community.

Crop survey.—Reports on present conditions of the various crops, yields if harvested, climatic, moisture, and soil conditions. Each child bring a list of estimated yields of various crops on his father’s ranch. How much sold? Amount consumed at home. This to include garden, field, orchard, and livestock. Problems of marketing.

Needs.—Special irrigation or drainage needs. Soil needs. Market needs, transportation needs, educational needs, etc.

Processes.—Pupils write out in detail the successive steps in the production of one crop, from the preparation of the seed bed to the final disposition of the product. State importance of each step. Describe all tools used. Estimated cost of production. Net revenue for the farmer. Is farming a paying business? Why?

Social interests.—Plans for community betterment. Work of the farm bureaus in a social way. What is the Grange doing for the social life of the farm? The Improvement Club or a Woman's Club? Plans of the Parent-Teachers Association. The school in play and recreation. The play festival in the community. How organize one. Program of play. See Curtis's *Play and Recreation in the Open Country*.



2. PLANT LIFE THROUGHOUT THE YEAR

Corn.—What varieties of corn are grown in the district? How many acres grown? Its use. Study of a plant in detail. Get a green plant. Characteristics of the root system. Kinds of roots. Depth and direction of growth of roots. Name all important details of the stem. Nodes and internodes. Study a cross-section of the stem. Arrangement of fibers. Work of fibers. Leaves, number and arrangement, how fastened to the stem, etc. Work of the leaves. The two flowers on the corn stalk. How placed on sweet corn? On milo maize? Review parts of flower in nasturtium, pollination, etc. How do these apply to the corn plant? Office of the tassel. Of the silk. How many silks on an ear of corn? What must happen before a grain of corn is formed? Explain cross-pollination and self-pollination. Explain fertilization method in the corn plant. Improvement of the corn plant by selection and breeding. Uses and history of corn. Valuable material on the origin and improvement of plants and

animals may be found in Davenport's *Domesticated Animals and Plants*. See also bulletins from the U. S. Department of Agriculture and a good text in elementary agriculture.

Wheat.—Extent of wheat raising in the district? In the state? Past importance of the wheat crop in California. Do we now raise enough in the state to supply state needs? Why? What has caused the decline of the wheat industry? What kinds of wheat raised in the district? Samples of different kinds in the schoolroom. Look for weed seed. What constitutes a well-prepared seed bed? When is wheat sown? Ways of sowing it. Study of wheat plant. Characteristics of stem as contrasted with stem of corn plant. Identify pedicle and blade of the wheat leaf. How joined to the stem? Note position of leaves along the stem. Are leaves parallel-veined or netted-veined? Study of root system. What is meant by a "fibrous" root system? What other kind? What other common plants have characteristics common to wheat so far as stem, leaves, and root are concerned? Study the head. Why called a spike? Note and describe rachis, spikelet, glume. If wheat is bearded, which glume bears the beard? Number of grains in a spikelet. Study of the flower of the wheat plant. Compare with flower of the corn plant. Ways of improving the wheat plant. History and uses of wheat.

Weeds.—What weeds are troublesome in the corn field? In the wheat field? Which are annuals? Biennials? Perennials? Which are most successful? Best method of combating each. Study these weeds in the fall when the flower and seed are available. Study one weed in detail as to height, color, and character of stem; method of branching; kind and manner of leaves; appearance of leaves on different parts of plant. Describe the flower. Where are the seeds? Appearance? Estimate number of seeds on a single weed. Name several things that make weeds successful plants. Study other weeds, noting like and unlike features to one already studied. In what ways are weeds injurious to growing crops? How are weeds injurious to animal life? Ways of scattering weeds. Collections of weed seeds in small vials with proper labels. See references at close of outlines on Weeds in the Sixth grade.

Alfalfa.—Discussion of legumes in general. Name other legumes besides alfalfa. Note habit of growth of alfalfa. Characteristics of stem, leaf, and flower. Study of the root system. Kind of root and its advantages. Locate tubercles or nodules. What are they? What are the bacteria and what do they do? Where do the bacteria get the nitrogen? How many pounds of nitrogen in the atmosphere over

every acre of ground? Value of alfalfa as a feed. Its value in a rotation system of cropping. Why? See “Alfalfa Culture” in Circular No. 121, “Some Things the Prospective Settler Should Know,” and Correspondence Course in Alfalfa Culture, both from College of Agriculture, University of California.

Garden crops.—Study carrot, parsnip, beans, and beets according to outlines in Home Garden and Vegetable Growing Projects.

Ornamental shrubs.—Study five native ornamental shrubs and a like number of exotic ornamental shrubs. How do shrubs differ from trees in the habits of growth? Emphasize the use of shrubs in masses on school and home grounds. The ABC's of landscape arrangement.



Draw designs on the blackboard and study arrangement of shrubs. Consult Landscape Gardening Division, College of Agriculture, University of California, for planting plans for school grounds employing trees and flowers as well as shrubs. See Hall's *Studies in Ornamental Trees and Shrubs*.

Ornamental flowers.—Study five annuals and a like number of perennials according to suggestions in outlines in previous grades. Emphasize landscape effects in plantings. Build up in children an appreciation of the more attractive environment of school and home. Teach correct principles of arrangement. See McLaren's *Gardening in California, Landscape and Flower*; Braunton's *The Garden Beautiful*; and Wickson's *California Garden Flowers, Shrubs, Trees, and Vines*.

Wild flowers.—Study five annuals and five perennials. See Payne's *California Wild Flowers and Native Shrubs and Trees*, and Parson's *Wild Flowers of California*.

Vines.—Find out what the pupils already know about vines in the community. Put list on the board. Study in detail three deciduous and three evergreen vines from that list. Classify as to annual or perennial. Where plant vines? Of what value in an ornamental way? See references given under ornamental and wild flowers above.

Ornamental trees.—Discussion on ornamental trees of the district. How classify them? Make list on blackboard. Which are native? Which are brought in from other states or countries? How to become acquainted with a tree. What special things to be noticed? How dis-



tinguish one tree from another. Comparison in trees of general outline, methods of branching, color of bark, outline of leaf, arrangement of leaves and twigs, value of tree for shade, etc. See Jepson's *Trees of California*, and Roger's *Getting Acquainted with Trees*.

Fruit trees.—General survey of the fruit trees of district. Number and kind of each. Make a special study of the apple tree or the pear tree, which ever is the more important fruit in the district. Have a successful grower give a short talk to the school on some Friday afternoon on new problems in growing a particular fruit. Get assistance of the county horticulturist or the farm advisor.

Arbor Day.—When? What the day means. Spirit of Arbor Day. How to plant a tree that will live. The best Arbor Day program for a school which has no trees, shrubs, vines, or flowers on its grounds. Character of the program usually given at such a school.

Harvest Home Festival.—Best of the garden, orchard, and farm with reference to vegetables, seeds, grains, fruits, grasses, flowers, etc., on exhibition in the schoolroom. Study artistic arrangement. Cultivate an appreciation of good materials mentioned in previous grades.

3. ANIMAL LIFE THROUGHOUT THE YEAR

Insects.—Study of insects in the Seventh and Eighth grades to be made in connection with plant study as far as possible. The success of a particular crop, may, to a great degree, depend upon a single insect in its environment. The plant life in any locality must guide in the selection of insects for study.

Grasshopper.—Review outlines given in the fifth grade. Make a more detailed study of the grasshopper as a type of the biting insect. See Comstock's *Handbook of Nature Study for Teachers* for valuable material on the detailed study of the grasshopper and insects in general. See also Essig's *Injurious and Beneficial Insects of California*.

Cottony Cushion Scale.—Description, life history, work, control, etc. See Essig, pp. 108–110.

Black Scale.—Essig, pp. 153, 154.

Grape Leaf Hopper.—Essig, p. 432.

Squash Bug.—Essig, pp. 202, 203.

Harlequin Cabbage Bug.—Essig, pp. 200, 201.

Alfalfa Caterpillar.—Essig, pp. 458–460.

Beneficial Insects.—Not all insects are injurious. On another page select two for study as the lady-bird beetle and the honey bee. Consult Essig's *Injurious and Beneficial Insects* and Comstock's *Handbook of Nature Study for Teachers*.

Birds.—General discussion of birds. See outlines of previous grades. Review of main characteristics of birds already studied. See lists on other pages.

Valley Quail.—Description, habits, food, protection.

Killdeer.—Characteristics and how beneficial to agriculture.

Western Mourning Dove.—Habits, food, etc. Why beneficial to agriculture.

Chickens.—General discussion of the poultry interest in the district. Value of chickens on the farm. Different kinds of poultry in the district. Characteristics of each breed. Food of chickens, housing, incubators, brooders, etc. Diseases of chickens. Marketing of poultry products. Detailed study of the hen; the leg and toes; wings, feathers, and arrangement; parts of a feather; manner of eating and drinking; sense organs, etc. For detailed information about the hen and bird life in general see Comstock's *Handbook of Nature Study for Teachers*. For help on care of poultry see correspondence course in Poultry Husbandry, College of Agriculture, University of California. See also bulletins U. S. Department of Agriculture, Wash-

ington, D.C., No. 287, "Poultry Management"; No. 64, "Geese and Ducks"; No. 51, "Standard Varieties of Chickens"; No. 236, "Incubators"; No. 200, "Turkeys"; No. 225, "Poultry House Construction."

Wild mammals.—Study California ground squirrel; chipmunk; gray squirrel. See descriptive matter on other pages. See also suggestions in outlines on mammals in the Sixth grade.

Hogs.—General discussion of the swine interest of the community. How many ranchers keep hogs? Description of the different breeds. How many breeds are found in the community? Care of swine. Food. Diseases. Value for food. Importance as a farm animal. See Circular no. 151, "Feeding and Management of Hogs," College of Agriculture, University of California.



4. PHYSICAL PHENOMENA AND THE INORGANIC WORLD

Heat.—Importance in agriculture. Review thermometer. Sources of heat. Methods of heating houses. Effects of heat upon solids, liquids, and gases. Work and heat. Principles of expansion and contraction. See Rowell's *Elementary General Science*, Book I; also Holden's *Real Things in Nature*.

Sound.—How caused? Sound waves. Difference between sound and music. The voice. How is sound carried? Velocity of sound. Compare with light. If there were no ear to hear would there be any sound?

Electricity.—Elementary discussion of how generated, use of batteries, etc. Relation to telegraph, telephone, railway, etc. Possibilities of electricity on the farm, lighting, cooking, etc. The dynamo and the gasoline engine.

Sky studies.—Recognition of a few of the most important and common constellations of stars. Movements and phases of the moon. Record of time of sunrise and sunset. See Ball's *Starland* and Pratt's *Storyland of Stars*.

Weather.—Conditions, changes, etc. Review all previous work on this subject. Especially emphasize the work of the Weather Bureau of the U. S. Department of Agriculture.

Atmosphere.—Review all previous work. Especially emphasize composition, weight, and pressure. Review barometer. Storms, winds, etc. Applications of pressure of air in practical affairs of life as the pump, vacuum cleaner, air brakes, etc.

VIII. OUTLINES FOR THE EIGHTH GRADE

1. HUMAN NEEDS, INTERESTS, AND ACTIVITIES

Roads.—Study of the public highway as a need of the community life. Condition of the roads in the district. How many roads? How did the roads happen to be where they are? Relation of old trails to present system of roads. The United States Land Survey and roads. Methods of securing new roads today. Principal features of State Highway Law. Material of which better roads are made. Methods of making better roads. Grading and drainage. Width of roads. Bridges. Use of concrete; road tools and implements. The maintenance of good roads. Taxation and bond issues. Trace California highway system on road map of the state. Social, educational, and economic value of good roads.

Crop survey.—What crops are harvested during the year? Make a list of crops grown in the community. Yields on various farms. Highest and lowest acre yield of the same crop. Average yield throughout the district. How many fields grow more than one crop in a single year? Pupils work out an agricultural map of district, showing different farm crops, location of pure bred herds of cattle, etc.; silos; canning factories; kinds of orchards; fruit exchanges, etc.

Sanitary conditions.—General study of health conditions of community as to water supply and drainage. Relation of certain insects to health. Means of protection. Local health board and its duties. Contagious diseases and regulations. Relation of bacteria to tuberculosis, diphtheria, scarlet fever, etc. Discussion of simple but effectual disinfectants. Sunshine and hot water in the school and at

home. Relation of school to community and personal hygiene. Principal state regulations with reference to pure food, pure milk, etc.

Farm machinery.—General discussion of value of machinery in general. Kinds of power used in operating farm machinery; the gasoline engine and its uses. Reasons for the use of improved machinery on the farm. List of different tools used on the farm in the preparation of the soil for the crop. Make a special study of the development of the plow and its place in the progress of the human race. How does the plow compare in importance with the sword? List of tools used in the seeding of crops; tools used in cultivation. Discuss in detail the evolution of harvesting machines from the reap hook to the combined harvester. Also the machines used in haying



of whatever kind. Describe special machinery for special crops as rice, beans, etc. Send to large implement houses for catalogues of farm machinery. Study these catalogues. Economic importance of proper care of farm machinery. Average length of life of a plow, a mower, a reaper. Money invested in farm implements on each farm. The total for the district. Estimated loss each year because of poor care of machinery. What is the proper care of a farm tool? Tools used in marketing products of farm, as wagon, automobile, etc. Care of fruit boxes and milk cans. The repair shop on the farm and list of repair tools. Brief discussion by teacher of machines in accordance with the six fundamental simple machines, viz., the lever, the pulley, the wheel and axle, the inclined plane, the wedge, the screw. Pupils encouraged to find illustrations of uses of these simple machines in the economy of the home and the farm.

Seasonal activities.—Summary of steps in various processes in farm operations, best methods as accepted by majority. Disputed points in various processes as pruning fruit trees; cultivation of orchards; irrigation; care of swine and poultry; filling the silo; use

of cover crops; returning organic matter to soil, as disposal of straw after wheat and beans have been threshed; conserving soil moisture, etc.

Home and vacation projects.—Activities of the various forms of the institutional life of the community, as the grange, farm bureau, farmers' club, women's club, church, home and school. Value of lecturers, concerts, picnics, play festivals, and various other healthful



forms of recreation. The schoolhouse as the center of social and recreational interests. Work of a Home and School Association. Coöperation of extension activities of the State College of Agriculture.

2. PLANT LIFE THROUGHOUT THE YEAR

Forage crops.—Meaning of the word “forage.” Classes, as the small grasses, the large grasses, the legumes, root crops, etc. Study in detail many of the forage crops listed on other pages. Review blue grass. The larger grasses include corn, Kafir corn, sorghum. Review study of common or Indian corn and then compare with Kafir corn. Note well the difference in the flowers of the two kinds. Value of Kafir and sorghum. See good elementary text in agriculture. Review what was outlined on alfalfa or legumes. Make a study of two other legumes as cowpeas and soy beans. Under miscellaneous forage plants are root crops for feeding to live stock as turnips, rutabaga, and beets. Study of such as are grown in the district. Discuss feeding value.

Plant communities.—Character of a plant. How it grows. Parts of the plant. Work performed by each part. Factors necessary for plant growth. The environment of a plant. Tendency of plants to form communities. What is a plant society? What determines a plant society? Children investigate and report on plant communities in the garden; the orchard; the lawn; the barnyard; the public road; the woods; the various crop fields, as wheat, barley, alfalfa, corn, etc. Plant communities may include weeds, wild flowers, useful plants, etc. Reports on all plants found growing together as if to make a community. Notice insect life found in connection with the plants. To what extent can man control a plant community? In this connection



review all that has been studied about weeds, the characteristics as to successful plants. Give as much time as possible in this connection to review the important things about the various garden, field, orchard, ornamental, and wild plants studied the previous years.

Additional plant studies, oats.—Characteristics of stem, leaves, and roots. Meaning of the “oat panicle.” Review outlines on wheat plant. Compare various points in the wheat plant with the oat plant. Value of oats for food. Why is oats considered a balanced ration for work horses? Uses of oat straw and wheat straw. Why is it regarded bad husbandry to burn straw after grain is threshed out? What is a better way? Diseases of the oat plant. What is smut? Its damage to the oat crop. Treatment for smut.

Barley.—In like manner make a study of the barley plant.

Seeds.—Study of characteristics and identification of grass seeds as timothy, Kentucky blue grass, orchard grass, Australian rye grass. The legume grasses as alfalfa, clovers (red, alsike, sweet, Burr).

Study samples of the various grass seeds sold to find percentage of adulteration with weed seeds. Get data from farmers, the farm advisor or the county horticulturist. Any law against selling adulterated grass seeds? Study of grain seeds as wheat, oats, barley, etc. Selection of seeds for planting—what determining factors? Improvement of crops through seed selection. Importance of the germination test before putting in the crop. Parts of a seed. See Farmers' Bulletins, U. S. Department of Agriculture.

Moulds, yeasts, and bacteria.—Why important? Help to destroy. Help to prepare some foods. Help to spread disease in plants and animals. Help in keeping up the fertility of the soil. See Comstock's *Handbook of Nature Study for Teachers*.



Plants and seeds as sources of foods.—Food in the apple, the bean, the potato, wheat, etc. Various food materials found as starch, oil, sugar, proteids, etc. Raw materials used by the plant to make foods. Sources of? Meaning of an element? Of a chemical compound? Illustrations. The ten elements that are absolutely necessary to grow a plant. See Patterson and Dexheimer's *Lesson Plans for Teachers in Nature Study Agriculture*, pp. 152–156.

Orchard problems.—Study of special problems of the orchard, whether pruning, spraying, cultivation, harvesting, fruit, etc. Keep in touch with discussions in current farm and horticultural papers and with bulletins issued by the State Horticultural Society and the State College of Agriculture.

Human and social importance of plant life.—Development of an appreciation of a more attractive environment. Materials for beautifying school and home grounds. The simple elements of a good landscape design. Actual participation by children in planting and caring for things planted.

The School and Community Fair.—Always an annual event. The opportunity to show achievement in the art of agriculture. The educational and economic values of developing admiration for the best products of the soil.

3. ANIMAL LIFE THROUGHOUT THE YEAR

General review of animal life on the farm.—Review outlines given in previous grades.

Dairying as a special study.—Economic importance of the dairy cow to the farm, the farm home, and the nation. The different pure



bred dairy herds in the district. Good points about each. Three means of increasing the efficiency of the cow, viz., better care, better feeds, and feeding and better breeding. Two tests for efficiency, viz., use of milk scale for quantity of milk and use of Babcock test for quality of milk. Sanitary production of milk. Study of new state law in this regard. The silo construction, value, and character of silage, etc. The cream separator and the creamery. Butter and cheese making. Various uses of milk. The best dairy cow in the community. The best dairyman. Why? Value of dairy products sold in the community. Study also of the beef type of cattle. Contrast with the dairy type.

Special study of the hen.—Economic importance of the hen to the farm and the nation. Better care of the farm hen. The best laying hen in the community. Care of young chicks. See correspondence courses on Dairy Husbandry, Swine Husbandry, Sheep Husbandry, and Poultry Husbandry, College of Agriculture, University of California.

4. PHYSICAL PHENOMENA AND THE INORGANIC WORLD

Soil.—Review work of previous years as to origin of soil, different types., etc. The following outline is suggestive for a more detailed study:

- (1) Character of the Earth's Crust.
- (2) Agencies in Soil Formation.
- (3) Physical Processes in Soil Formation.
- (4) Chemical Processes in Soil Formation.
- (5) Successive Steps in Evolution of Soil.



- (6) The Major Soil-forming Materials.
- (7) Rocks as Soil Formers.
- (8) General Classification of Soils.
- (9) General Physical Constituents of Soils.
- (10) Leading Types of Farm Soils.
- (11) Organic Matter in Soils.
- (12) Soil Water.
- (13) Soil Air.
- (14) Soil Temperature.
- (15) Cultivation of Soil.
- (16) How Maintain Soil Fertility.
- (17) Importance of Crop Rotation.

Physical phenomena.—Review previous grades and emphasize any new data that has direct relation to agriculture.

MATERIALS FOR STUDY IN THE RURAL SCHOOLS OF CALIFORNIA

The following lists of materials are suggested by various members of the staff of the College of Agriculture of the University of California.

I. FARM CROPS

By PROFESSOR J. W. GILMORE

Wheat—

White Australian—A bearded wheat of good milling quality.

Sonora—A beardless wheat of good milling quality.

Club—A beardless, compact head wheat, non-shattering and drought-resistant.

Barley—

Bay—6-rowed type for feed.

Hennchen—2-rowed type for malting.

Hooded—A beardless hooded type.

Oats—

Black—Grows to good advantage along coast.

Red—Suitable for valleys.

Yellow—Suitable for valleys.

Corn—

White dent—(Mexican June).

Yellow dent—(Pride of the North).

Yellow flint.

Sugar.

Pop.

Rye—

Any variety.

Sorghum—

Feterita—An erect white seed variety.

Milo—A yellow gooseneck variety.

Shallu—An open-headed variety.

Rice—

Japanese type—Short grain.

Honduras—Long grain.

Bluegrass—For lawns requires much water.

Foxtail—Mostly a weed, beards very stiff when ripe.

Grasses:

Rye—Hay and lawn grass for coast counties.

Timothy—Hay grass for northern and eastern counties.

Bluegrass—For lawns requires much water.

Foxtail—Mostly a weed; beards very stiff when ripe.

Alfalfa—Any variety.

Vetch—Winter.

Rape—Dwarf Essex.

Clover—White; red.

Potato—

Early rose—Red skin and early.

Burbank—White skin and late.

Beans—

Lima—Pole variety for coast counties

Pink—For valley conditions.

Tepary—For very dry conditions.

Blackeye—A cowpea for valley conditions.

Sugar Beets—

Any variety.

Cotton—

Durango—Short staple, linted seed.

Egyptian—Long staple, naked seed.



II. COMMON INJURIOUS AND BENEFICIAL INSECTS

By PROFESSOR E. O. ESSIG

1. INJURIOUS

a. To Orchards

(DECIDUOUS)

1. Woolly apple aphid (*Eriosoma lanigera*).
2. Green apple aphid (*Aphis pomi*).
3. Walnut aphid (*Chromaphis juglandicola*).
4. European fruit lecanium or brown apricot scale (*Lecanium corni*).
5. San Jose scale (*Aspidiotus perniciosus*).
6. Oyster-shell scale (*Lepidosaphes ulmi*).
7. Pear thrips (*Taeniothrips pyri*).
8. Lesser shot-hole borer (*Xyleborus xylographus*).
9. Flat-headed apple tree borer (*Chrysobothris femorata*).
10. Peach twig borer (*Anarsia lineatella*).
11. California peach borer (*Aegeria opallescens*).
12. Spring cankerworm (*Paleacrita vernata*).
13. Red-humped caterpillar (*Schizura concinna*).
14. Forest tent caterpillar (*Malacosoma disstria*).
15. Codling-moth (*Cydia pomonella*).
16. Pear or cherry slug (*Caliroa cerasi*).

(CITRUS)

17. Cottony cushion scale (*Icerya purchasi*).
18. Gray citrus or citricola scale (*Coccus citricola*).
19. Soft brown scale (*Coccus hesperidum*).
20. Citrus mealy bug (*Pseudococcus citri*).
21. Black scale (*Saissetia oleae*).
22. Red scale (*Chrysomphalus aurantii*).
23. Purple scale (*Lepidosaphes beckii*).
24. Fuller's rose beetle (*Pantomorus fulleri*).

b. To Grapes and Berries

25. Grape leaf-hopper (*Erythroneura comae*).
26. California grape root-worm (*Bromius obscurus*).
27. Currant or Gooseberry fruit-fly (*Epochra canadensis*).
28. Strawberry crown moth (*Aegeria rutilans*).
29. White-lined sphinx (*Celerio lineata*).
30. Raspberry horn-tail (*Hartigia cressoni*).

c. To Garden

31. Green pea aphid (*Macrosiphum pisi*).
32. Melon aphid (*Aphis gossypii*).
33. Squash bug (*Anasa tristis*).

34. Harlequin cabbage bug (*Murgantia histrionica*).
35. Bean thrips (*Heliothrips fasciatus*).
36. Wester 12-spotted cucumber beetle (*Diabrotica soror*).
37. Sugar beet wireworm (*Limonius californicus*).
38. Potato flea-beetle (*Epitrix eucumeris*).
39. Western radish maggot (*Phorbia planipalpis*).
40. Variegated cutworm (*Lycophotia margaritosa*).
41. Corn ear-worm (*Chloridea obsoleta*).
42. Potato tuber moth (*Phthorimaea operculella*).
43. Imported cabbage worm (*Pontia rapae*).



d. *To Forage Crops and Cereals*

44. Devastating grasshopper (*Melanoplus devastator*).
45. Oat aphid (*Aphis avenae*).
46. Tarnished plant-bug (*Lygus pratensis*).
47. Alfalfa caterpillar (*Eurymus eurytheme*).

e. *To Stored Products*

48. Bean weevil (*Acanthoscelides obtectus*).
49. Pea weevil (*Bruchus pisorum*).
50. The granary weevil (*Calandra granaria*).
51. The rice weevil (*Calandra oryzae*).
52. Angoumois grain moth (*Sitotroga cerealella*).

f. *To Flowers and Ornamentals*

53. Rose aphid (*Macrosiphum rosae*).
54. Green peach aphid (*Rhopalosiphum persicae*).
55. European elm scale (*Gossyparia ulmi*).
56. Greedy scale (*Aspidiotus camelliae*).
57. Ivy or oleander scale (*Aspidiotus hederae*).
58. Greenhouse white fly (*Asteriothiton vaporariorum*).
59. Rose snout-beetle (*Rhynchites bicolor*).
60. Mourning cloak butterfly (*Euvanessa antiopa*).
61. Thistle butterfly (*Vanessa cardui*).

2. BENEFICIAL

a. *Attacking Insects*

1. Common red black-spotted ladybird beetle (*Hippodamia convergens*).
2. The vedalia (*Novius cardinalis*).
3. Large syrphid fly (*Syrphus pyrastris*).
4. Parasite of European Fruit Lecanium (*Comys fusca*).
5. Scutellista (*Scutellista cyanea*).

b. *Pollenizers*

1. Blastophaga (*Blastophaga psenes*).
2. The honey bee (*Apis mellifica*). Also producer of a very important commercial product.

III. TROUBLESOME WEEDS IN CALIFORNIA FOR STUDY IN THE RURAL SCHOOLS

BY PROFESSOR P. B. KENNEDY

MORNING GLORY (*Convolvulus arvensis*).—Occurring first as patches which may spread eventually over entire fields if not controlled. Troublesome in garden, orchard, and fields. A creeping plant with pernicious underground stems. Eradicated by suppression of the leafage which starves the rootstocks.

JOHNSON GRASS (*Andropogon halepense*).—Troublesome only where winters are not severe as in southern California. Has large rootstocks which may penetrate to a depth of 4 feet in the orchards and fields. Eradicated by severe and continuous pasturing or by same method as morning glory.

DODDERS OR LOVE VINES (*Cuscuta sp.*).—Parasite on alfalfas and clovers, sucking the nourishment from them for their own use and finally destroying and taking the place of the host plant. Remedy, sow clean seed. Eradication by cutting and burning before going to seed. Reseeding with grass or grain or tillable crop for a period of one or two years. Then replant to alfalfa, using clean seed.

MUSTARDS (*Brassica sp.*).—Some produce as many as 15,000 seeds on a single plant. Troublesome chiefly in grains, especially in regions of continuous cropping. Seeds will lie dormant in the ground a long time, ten or fifteen years, and yet when brought near the surface will germinate. Remedy, clean seed and summer fallowing. Harrowing grain when young to destroy young and tender mustard plants. Spraying with iron-sulphate.

BARNYARD GRASS OR WATER GRASS (*Echinochloa crus-galli*).—Unusually troublesome in rice fields, finally choking rice out. Sometimes three-fourths of the rice crop is water grass. Remedy, clean seed and pulling out and cutting the plants off below the crown with a hooked knife. Making clean and perfect seed bed so as to give the rice plants every chance.

- COAST DANDELION (*Hypochaeris radicata*).—Has taken thousands of acres of pasture lands on the immediate coast. Remedy, grow grain for several years and prevent going to seed. Summer fallowing. Lawns and waste places of Berkeley.
- STAR THISTLE, NAPA THISTLE, TOCALOTE (*Centaurea sp.*).—Common weeds in grain fields. Interfering with harvesting. Lessens the yield. Remedy, sow clean grain—prevent seed production. Hand pull where not too abundant. Change to intertilled crop where possible. Clean summer fallow.
- BERMUDA GRASS (*Cynodon dactylon*).—A persistent grass, troublesome chiefly in orchards. Portions of the plant separated in cultivation easily root and produce new plants. Spreads rapidly. Remedy, repeated shallow plowing so as to expose roots to sun and frost. Sow the land to a crop which will produce dense shade which it dislikes, e.g., cowpeas.
- SOUR CLOVER (*Melilotus indica*).—A valuable cover crop and at the same time a plant which causes great money loss to the wheat grower. A few seeds in a sack of wheat will taint the whole sack and make the flour unsalable. Remedy, being an annual, control by not allowing to go to seed. Thorough cleaing of grain at harvesting. Extremely abundant in California.
- WILD RADISH (*Raphanus raphanistrum*).—Particularly abundant in the coast region in oat fields. Looks like a mustard, except that the flowers are white or very pale yellow with purple veins, and the pods are constricted between the seeds. Remedy, try to stimulate seeds to germinate by cultivation and destroy young plants before seeding down to grain. Hand pull before seeding. Treatment with iron sulphate not quite so successful as with the mustards. Eaten by sheep and goats.
- MAYWEED OR DOG FENNEL (*Anthemis cotula*).—Roadsides, fields, vacant lots, grain fields, and pastures. Not eaten by stock, hence allowed to multiply and take up space where useful forage plants should be growing. Remedy, as it is an annual, persistent prevention of seed production will eradicate it. In grain fields, in some soils, the seedlings might be harrowed out in spring. Ill-smelling foliage, white daisy-like flowers.
- MILK THISTLE (*Silybum marianum*).—Recognized by its flecks of white on large prickly green leaves. Most abundant in the Bay region, but extending north to Mendocino and south to Los Angeles. Troublesome mostly in pastures, vacant lots, roadsides. Ordinance against it in Alameda County. Remedy, spud below the ground when the plants are young in February. An hour's work at this time will save five later on. Prevent the plants going to seed. Plow and put into a cultivated crop. Stock do not care for it and so patches in pasture keep getting larger.
- NUT GRASS (*Cyperus rotundus*).—A sedge resembling a grass which bears little tubers on its roots the size of the kernels of a hazel nut. Propagates both by seeds and by these nutlets. Troublesome only when it gets into orchards. The tubers withstand almost any degree of drought. Remedy, cut the stems so as to starve the roots and tubers. Plowing and cultivating seems only to give the weed renewed vigor. Hogs are very fond of it and will root for the ground nuts.
- PLANTAIN OR BUCKHORN (*Plantago Lanceolata*).—In lawns and waste places but especially troublesome in coast pastures. It has a strong perennial tap root which penetrates the soil for a foot or more, making it drought

resistant. Cattle feed on it when it grows tall enough, but it is bitter and not a desirable plant for dairy stock. Sheep eat it and do well on it. It occupies space in the pastures that should be growing more valuable forage plants. Remedy, change of crop from pasture to grain or an inter-tilled crop for a period of years before reseeding. Sow clean seed.

SOUR DOCK OR SORREL (*Rumex acetosella*).—A frequenter of rather dry sandy or loamy soils, especially on the coast. It is a strong perennial spreading rapidly by means of slender rootstocks. The leaves are decidedly sour and disliked by stock. When present in any considerable quantity, it usually means a poor or acid soil. Remedy, it dislikes lime so apply heavy applications of lime which will encourage other and better forage plants. Cultivate the surface frequently and thoroughly so as to expose the rootstocks.



CURLED DOCK (*Rumex crispus*).—We often see considerable areas of our pasture lands, especially in the low places, occupied by this weed. Unlike the sour dock, it has a long tap root. Cattle never eat it, so that it is left undisturbed to seed abundantly. Remedy, pull up by the roots when the ground is thoroughly soaked by rains or irrigation. Keep cutting just below the crown so as to starve the roots. Change from pasture to grain or intertilled crops.

IV. FLOWERS, SHRUBS, VINES, AND BULBS

BY PROFESSOR R. T. STEVENS

a. 20 CALIFORNIA WILD FLOWERS

1. *Annuals*

Clarkia elegans.

California Poppy (*Eschscholtzia californica*).Bird's Eyes (*Gilia tricolor*).Blazing Star (*Mentzelia lindleyi*).Farewell to Spring (*Godetia grandiflora*).Baby-Blue-Eyes (*Nemophila menziesii*).White Daisy (*Layia glandulosa*).Wild Canterbury Bells (*Phacelia whittlava*).Blue Lupine (*Lupinus affinus*).Innocence (*Collinsia bicolor*).2. *Perennials*Indian Paint Brush (*Castilleja martini*).Scarlet Larkspur (*Delphinium cardinale*).

Encelia californica.

Pride of California (*Lathyrus splendens*).Yellow Tree Lupine (*Lupinus arboreus*).White Evening Primrose (*Oenothera californica*).Scarlet Honeysuckle (*Pentstemon cordifolius*).Blue Pentstemon (*Pentstemon spectabilis*).Romero or Woolly Blue curls (*Trichostema lanatum*).California Fuschia (*Zauschneria californica*).

b. 25 CULTIVATED FLOWERS

1. *Annuals*Cornflower (*Centaurea cyanus*).

Petunia hybrida.

Shirley Poppy (*Papaver rhoeas*).Scarlet Flax (*Linum perenne*).Nasturtium (*Tropaeolum*).Sweet Pea (*Lathyrus odoratus*).African Marigold (*Tegetes*).Sweet Alyssum (*Alyssum maritimum*).

Verbena hybrida.

Sea Lavender (*Statice sinuata*).

Zinnia.

Butterfly Flower (*Schizanthus wisetonensis*).2. *Perennials*Candytuft (*Iberis sempervirens*).

Coreopsis lanceolata.

Pentstemon gloxiniioides.

Gaillardia grandiflora.

Shasta Daisy (*Chrysanthemum leucanthemum*).
 Larkspur (*Delphinium hybridum*).
 Valerian Centranthus ruber.
 Geum coccinea Mrs. Bradshaw.
 Morning Bride (*Scabiosa maxima*).
 Canterbury Bells (*Campanula persicifolia*).
 Marguerite (*Chrysanthemum frutescens*).
 Gaura lindheimeri.
 Hollyhock (*Althea rosea*).



c. 15 NATIVE ORNAMENTAL SHRUBS

Catalina Island Cherry (*Prunus illicifolia integrifolia*).
 Madrone (*Arbutus menziesii*).
 Christmas Berry (*Heteromeles arbutifolia*).
 Wild Lilac (*Ceanothus thyrsiflorus*).
 Coffee Berry (*Rhamnus californica*).
 Pale Verde (*Parkinsonia aculeata*).
 Silk Tassel Bush (*Garrya fremontii*).
 Sour Berry (*Rhus integrifolia*).
 Carpenteria californica.
 Matilija Poppy (*Romneya coulteri*).
 Oregon Grape (*Mahonia aquifolium*).
 Fuschia-Flowered Gooseberry (*Ribes speciosum*).
 Monkey Flower (*Diplacus glutinosus*).
 Snowberry (*Symphoricarpos racemosus*).
 Sweet-scented Shrub (*Calycanthus occidentalis*).

d. 20 EXOTIC ORNAMENTAL SHRUBS

1. *Deciduous*

Japanese Quince (*Cydonia japonica*).
 Weigela (*Diervilla Van Houttei*).
 Bridal Wreath (*Spiraea cantoniensis*).

2. *Evergreen*

- Abelia grandiflora.
- Darwin's barberry (*Berberis darwinii*).
- Mexican Orange (*Choisya ternata*).
- New Zealand Looking Glass Plant (*Coprosma baueri*).
- Cotoneaster franchetti.
- Escallonia montevidensis.
- Escallonia rubra.
- Small-flowered Fuchsia (*Fuchsia magellanica*).
- Italian yellow Jasmine (*Jasminum humile*).
- Australian Tea (*Leptospermum laevigatum*).
- Scarlet Bottlebrush (*Melaleuca hypericifolia*).
- Common Myrtle (*Myrtus communis*).
- Black-stemmed Pittosporum (*Pittosporum tenuifolium*) [*nigricans*].
- Burning Bush (*Pyraecantha coccinea*) [*Crataegus*].
- Evergreen Thorn (*Pyraecantha erenulata*) [*Crataegus*].
- Rapiolepis japonica.
- Veronica decussata.

e. 25 VINES

1. *Deciduous*

- Akebia quinata.
- Boston Ivy (*Ampelopsis tricuspidata*).
- Virginia Creeper (*Ampelopsis quinquefolia*).
- Mountain Clematis (*Clematis montana*).
- Blue Dawn Flower (*Ipomoea learii*).
- Trumpet Vine (*Tecoma grandiflora*).
- Chinese Wistaria (*Wistaria chinensis*).
- Cobaea scandens.
- Wild Pea Vine (*Lathyrus latifolius*).
- Snail Vine (*Phaseolus caracalla*).
- Actinidia Chinensis.

2. *Evergreen*

- Australian Pea Vine (*Dolichos lignosus*).
- English Ivy (*Hedera helix*).
- Common Jasmine (*Jasminum officinale*).
- Japanese Honeysuckle (*Lonicera japonica halliana*).
- Maiden-hair Vine (*Muchlenbeckia complexa*).
- Passion Vine (*Passiflora caerulea*).
- Tecoma jasminoides.
- Bignonia tweediana.
- Evergreen Grape (*Vitis californica*).
- Chile Jasmine (*Mandevilla suaveolens*).
- Potato Vine (*Solanum jasminoides*).
- Evergreen Ampelopsis (*Cissus striata*).
- Yellow Jasmine (*Jasminum primulinum*).
- Carolina Yellow Jasmine (*Gelsemium sempervirens*).

f. BULBS WHICH MAY BE PLANTED OUTDOORS IN FALL FOR SPRING AND SUMMER BLOOMING

Daffodils or Jonquils—

- Large crown or trumpet type

Bicolor
Yellow
Short trumpet type
Incompariblis
Poet's
Double-flowered

Narcissus—

Polyanthus type—Paper
white

Iris—

Spanish in variety
German in variety
English in variety

Gladiolus—

Early dwarf types
Blushing Bride
Peach Blossom
The Bride
America



V. TROPICAL AND SEMI-TROPICAL FRUITS FOR STUDY IN CALIFORNIA RURAL SCHOOLS

By PROFESSOR IRA J. CONDIT

Lemon.—Eureka, Lisbon, Villa Franca.

Orange.—Washington Navel, Valencia, Mediterranean Sweet.

Grapefruit.—Marsh, Duncan, Triumph.

Fig.—Calimyrna, Adriatic, Mission.

Avocado.—Taft, Sharpless, Harman.

Date.—Deglet Nur, Thuri, Hayani.

Loquat.—Champagne, Advance, Thales.

Japanese Persimmon.—Hachiya, Tanenashi, Hyakume.

Guava.—Strawberry.

Pomegranate.—Wonderful.

VI. LIST OF SOME COMMON CALIFORNIA TREES FOR STUDY IN RURAL SCHOOLS

BY PROFESSOR W. METCALF

Pinaceae—Pine Family.

- Sugar Pine (*Pinus lambertiana*).
- Western Yellow Pine (*Pinus ponderosa*).
- Digger Pine (*Pinus sabiniana*).
- Knobcone Pine (*Pinus attenuata*).
- White Fir (*Abies concolor*).
- Grand Fir (*Abies grandis*).
- Douglas Fir (*Pseudotsuga tacifolia*).

Cupressaceae—Cypress Family.

- Monterey Cypress (*Cupressus macrocarpa*).
- Incense Cedar (*Libocedrus decurrens*).
- Sierra Juniper (*Juniperus occidentalis*).
- Port Oxford Cedar (*Chamaecyparis lawsoniana*).

HARDWOODS OR BROADLEAVED TREES

Juglandaceae—Walnut Family.

- California Black Walnut (*Juglans californica*).

Fagaceae—Oak Family.

- Valley Oak (*Quercus lobata*).
- Coast Live Oak (*Quercus agrifolia*).
- California Black Oak (*Quercus kelloggii*).

Lauraceae—Laurel Family.

- California Laurel (*Umbellularia californica*).

Platanaceae—Sycamore Family.

- Western Sycamore (*Platanus racemosa*).

Leguminosae—Pea Family.

- Mesquite (*Prosopis juliflora*).
- Black Locust (*Robinia pseudacacia*).

Sapindaceae—Buckeye Family.

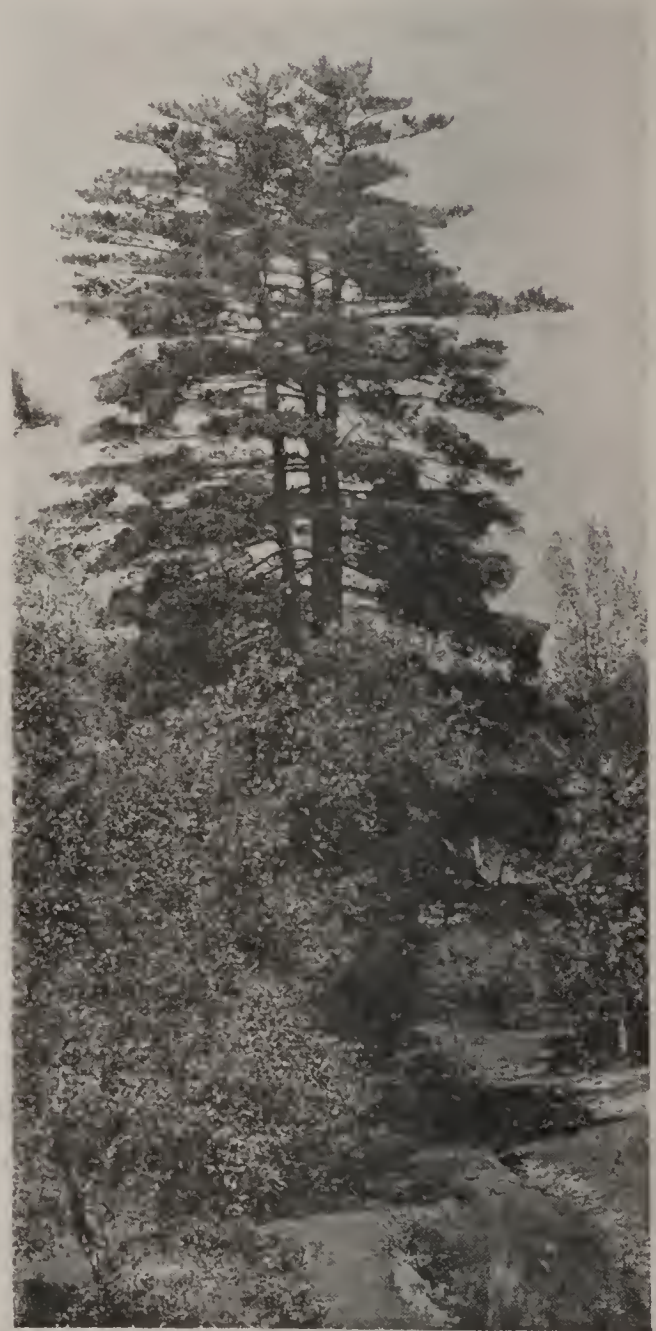
- California Buckeye (*Aesculus californica*).

Aceraceae—Maple Family.

- Broadleaf Maple (*Acer macrophyllum*).
- California Box Elder (*Acer Negundo* [*Californicum*])

Ericaceae—Heath Family.

- Madrona (*Arbutus menziesii*).



VI. CLASSES OF SOIL

By PROFESSOR C. F. SHAW

SOIL.—The soil is a mass of finely ground and altered rock material mixed with a small amount of decaying organic material (or humus). Rocks are chipped and broken by alternating heating and cooling, are worn away or dissolved by water and are worn and altered by air.

Sedentary Soils are those in which the material has not been moved or transported from the place where it was formed.

Residual Soils are sedentary soils formed by the accumulation of soil material through the decay and pulverization of rocks. Residual soils in many ways resemble the rocks from which they are formed.

Cumulose Soils are sedentary soils that are formed by the accumulation of decayed plant remains. Peat and muck are those most commonly found.

Transported Soils are those in which the soil material has been carried some distance from its origin and deposited in a new location.

Alluvial Soils are those that have been moved and deposited by water.

PHYSICAL CHARACTER OF SOILS

Sand.—Sand is loose and granular. The individual grains can readily be seen or felt. Squeezed in the hand when dry, it falls apart when the pressure is released. Squeezed when moist it will form a cast, but will crumble when touched.

Sands are classified as coarse, medium, fine or very fine sands, depending on the size of the grains that compose them.

Sandy Loam.—A sandy loam is a soil containing much sand but which has enough silt and clay to make it somewhat coherent. It has a gritty feel, and the sand grains can readily be seen. Squeezed when dry, it forms a cast which can be easily broken, but if squeezed when moist, a cast is formed that can be handled carefully without breaking.

Sandy loams are classed as coarse, medium, fine or very fine sandy loams, depending on the size of the grains that compose them.

Loam.—A loam is a soil having an even mixture of the different size grades of sand and of silt and clay. It is soft and mellow with a somewhat gritty feel, yet fairly smooth and rather plastic. Squeezed when dry, it forms a cast that will bear handling, while the moist cast can be handled very roughly without breaking.

Silt Loam.—A silt loam is a soil having little sand and only a small amount of clay, over half of the grains being of the size called "Silt." It may appear quite cloddy but the lumps can be readily broken, and when pulverized it feels soft and floury. Either dry or moist it will form casts that can be freely handled without breaking.

Clay Loam.—A clay loam soil in the field is dense and compact and breaks into clods or lumps. These are hard to break when dry, but when moist can be pinched between the thumb and finger to form a thin ribbon. The moist soil is plastic and does not crumble readily.

Clay.—A clay soil is dense and compact, forming very hard lumps or clods. It is composed of very fine particles, which stick together to make a very plastic or putty-like mass when wet. The soil can be pinched out to form a long, flexible “ribbon.”

Adobe.—The term “adobe” indicates a structural condition. Any soil that will shrink on drying and break into blocks with wide cracks is called an adobe. Most adobes are clay adobes but there are clay loam adobes, and even sandy loam adobes have been found.

All of the above classes of soil, if mixed with a considerable amount of gravel, or of stone, may be classed as gravelly sandy loam, gravelly clays, etc., or as stony sandy loams, etc. Sandy clay, or sandy clay loams may also occur.

Alkali is a term applied to the accumulation of soluble salts in the soil in injurious amounts. “White” alkali is made up mainly of sodium chloride or common salt and sodium sulphate or glauber’s salt. “Black alkali” occurs when there is present a quantity of sodium carbonate or washing soda (sal soda). Alkali accumulates wherever there is poor drainage, and where there is more water leaving the soil by evaporation than goes down through it during rains.

Alkali can sometimes be made harmless by the application of chemicals, but the most satisfactory method is to remove it by draining and washing the salts out.

VIII. COMMON VARIETIES OF FRUITS

BY PROFESSOR R. H. TAYLOR

ALMONDS

Nonpareil
I. X. L.
Ne Plus Ultra
Drake

WALNUTS

Franquette
Eureka
Placentia

PECANS

Stuart
Schley
Success
Money-maker

CHESTNUTS

Paragons
Boone
Rochester

FILBERTS

Du Chilly
Barcelona
D’Alger
Aveline, Red



APPLES

Yellow Newton
Delicious
Baldwin
Ben Davis
Rome Beauty
Winesap
Gravenstein

Yellow Bellflower
White Pearmain
Red Astrachan

PEACHES

Elberta, free, Shipping
Crawford, free, Shipping
Muir, free, Drying
Lovell, free, Drying

Tuscan, cling, Canning	PRUNES	STRAWBERRIES
Phillips, cling, Canning	French	Jessie
PEARS	Robe de Sargent	Dollar
Bartlett	Imperial	Longworth
Winter Nelis	Sugar	Oregon
Comice	CHERRIES	Marshall
QUINCES	Napoleon Bigarreau	RASPBERRIES
Champion	(Royal Ann)	Cuthbert
Orange	Black Tartarian	BLACKBERRIES
NECTARINES	Bing	Lawton
Stanwick	Black Republican	Mammoth
Boston	APRICOTS	Himalaya
PLUMS	Royal	LOGANBERRIES
Wickson (Jap)	Blenheim	Logan
Climax (Jap)	Moorpark	Phenomenal
Grand Duke	PLUMCOTS	HUCKLEBERRIES (Wild)
Diamond	Rutland	SALMON BERRIES (Wild)

IX. COMMON CALIFORNIA BIRDS

By PROFESSOR HAROLD C. BRYANT

The following birds have been selected from more than five hundred different varieties found in California as being those most commonly met with. As a check list of the commoner birds this list will be helpful but for more detailed descriptions and habits resort must be made to various books on birds. It should be remembered that not all of the birds here listed are to be found in one locality or at one season of the year.

WESTERN GULL (*Larus occidentalis*).—The commonest gull found along the California coast; recognized by its slaty-gray back and wings, black wing-tips and white head and underparts; young gulls are brownish with underparts streaked. Permanently resident, nesting on the Farallone Islands. A valuable scavenger.

GREAT BLUE HERON (*Ardea herodias herodias*).—A large, bluish bird with extremely long legs usually seen wading at the edges of shallow ponds. Permanently resident. Valuable as a destroyer of pocket gophers, which it catches by watching the gopher hole like a cat.

MALLARD (*Anas platycynchos*).—Male, with green head, white neck-ring, and chestnut breast; female, dark brown streaked with lighter brown; both sexes with metallic purple patch on wing. Usually seen on or around ponds, lakes, or streams. Permanently resident. Considered our best table duck; feeds on grain and seeds of aquatic plants.

COOT OR MUDHEN (*Fulica americana*).—Slate-colored, with white bill; the commonest species of waterfowl found on lakes and ponds. Permanently resident. Feeds on grains, seeds, and other vegetable matter; inferior to ducks for the table.

KILDEER (*Oxyechus vociferus*).—Back brown; underparts white; black ring around neck and black band on breast. Usually seen in the vicinity of ponds and lakes; runs rapidly on ground and is noisy on the wing. Permanently resident. Feeds on snails, worms, and small insects obtained on moist ground. Beneficial to agriculture.

VALLEY QUAIL (*Lophortyx californica*).—Helmet-like topknot drooping over bill; general tone of coloration gray; white and black markings on head and throat; breast slaty; rest of underparts scaled with black; brown spot on belly. Usually seen on ground in brushy areas, vineyards, orchards, and grain fields. Permanently resident. Food chiefly weed seeds but some insects are taken; a fine game bird.



WESTERN MOURNING DOVE (*Zenaidura macroura marginella*).—Olive brown; tail long and pointed, broadly tipped with white on each side; sides of neck iridescent purplish and greenish. Usually found feeding on ground in open fields; when at rest perched in trees. A summer visitant, but winters to some extent in southern California. Eats quantities of weed seeds and hence is beneficial to agriculture; considered a game bird in California.

TURKEY VULTURE OR TURKEY BUZZARD (*Cathartes aura septentrionalis*).—Large, black, with red featherless head. Usually seen flying high in air with motionless wings. A summer visitant in northern California, but permanently resident in southern California and in the interior valleys. Valuable as a scavenger; feeds on carrion.

WESTERN RED-TAILED HAWK (*Buteo borealis calurus*).—Large, brown bird usually seen circling high in air with set wings. Permanently resident. Valuable as a destroyer of rodent and insect pests; seldom if ever attacks poultry.

COOPER OR BULLET HAWK (*Accipiter cooperi*).—A fast flying hawk of medium size with light spotted breast, slaty back, and long tail banded with dark brown. Usually seen darting with quick stroke of wing near trees and thickets or high in air. A permanent resident. *This is the real chicken hawk.* Feeds on birds of all kinds, often preying upon quail and poultry. *The sharp-skinned hawk* is similar to the cooper hawk in coloration and habits but is only half its size, and a winter visitant; both are unprotected by law.

SPARROW HAWK (*Falco sparverius sparverius*).—Small reddish-brown hawk with black cheek marks. Usually seen perched on telegraph or fence posts or hovering over open fields. Permanently resident. Beneficial as a destroyer of grasshoppers, crickets, and mice; seldom if ever attacks birds.

BARN OWL OR MONKEY-FACED OWL (*Aluco pratincola*).—Upper parts finely mottled with gray and light brown; under parts white or light brown; face whitish. Usually seen in barns, hollow trees, or in the evening flying in search of food. Permanently resident. One of the most valuable of birds; feeds largely on the pocket gopher; has been known to capture as many as fifteen pocket gophers in one night.

BURROWING OWL OR BILLY OWL (*Speotyto cunicularia hypogasa*).—Brownish, barred with lighter brown and white; legs long for an owl; usually seen at entrance to squirrel burrow or perched on fence post. Permanently resident. Feeds on mice, ground squirrels, lizards, beetles, grasshoppers, and other insects; a valuable ally of the farmer.

RED-SHAFTED FLICKER OR YELLOWHAMER (*Colaptes cafer collaris*).—Upper parts pinkish brown barred with black; shafts of tail beneath and under side of wings, red; black collar; conspicuous white rump patch. Permanently resident. Feeds largely on ants, as many as 3000 having been found in a single stomach; also takes wood-boring insects and small quantities of wild fruit; does not injure orchard trees.

CALIFORNIA WOODPECKER (*Melanerpes formicivorus bairdi*).—Upper parts black; under parts and rump white; forehead white; chin black margined with whitish; black patch on breast; white patch on wings shown in flight. Permanently resident. Usually seen on trunks and branches of trees, especially on those of oak. Acorns are the favorite food of this bird; these are stored in holes drilled in the bark of trees; ants and other insects are also eaten.

PACIFIC NIGHTHAWK (*Chordeiles virginianus hesperis*).—Dusky black, barred with gray and brown; white patches on wind and throat. Usually seen in the evening flying high in the air or over thickets; flushed from ground in daytime on occasions. A summer visitant only. Feeds on flying insects such as ants, mosquitoes, flies, and moths; especially valuable as a destroyer of mosquitoes.

ANNA HUMMINGBIRD (*Calypte anna*).—Upper parts iridescent green; top of head, throat, and ruff metallic pink, bronze and green in male. Usually seen poised in mid-air over flowers, gathering food. Permanently resident. Feeds on tiny insects and nectar found in flowers.

BLACK PHOEBE (*Sayornis nigricans*).—Head and upper parts blackish; underparts white; crest on head. Usually seen about small bodies of water, bridges, barns, and houses. Permanently resident. A fine destroyer of the common house fly, which it sometimes procures from window panes and window screens; other flying insects are also eaten.

WESTERN KINGBIRD OR BEE MARTIN (*Tyrannus verticalis*).—Head and back grayish; underparts yellow; tail black with outer feathers edged with white; a patch of scarlet on crown of head usually concealed by feathers. Usually seen in open country or perched on telegraph wires or fences. A summer resident. Feeds almost entirely on insects, many of which are injurious; when feeding upon bees takes drones rather than workers.

CALIFORNIA JAY (*Aphelocoma californica californica*).—Head and back bright blue; breasts and underparts whitish; long tail. Usually seen in orchards, thickets, or wooded areas. Permanently resident. Feeds largely on acorns, seeds, and fruit but is often destructive to fruit and almond orchards and to the eggs and young of song birds and even poultry. The darker blue jay with a crest found in the mountains is the *Blue-fronted Jay*.



WESTERN MEADOWLARK (*Sturnella neglecta*).—Above streaked with gray and brown; yellow below with black collar on breast; two outer tail feathers white; bill about as long as head. Usually seen in open fields on the ground but sometimes perched on telegraph poles and fence posts. Permanently resident. Feeds on grain, seeds, and insects; as a rule a valuable ally of the farmer because of its destruction of insect pests, such as grasshoppers, crickets, wireworms, and cutworms.

BULLOCK ORIOLE (*Icterus bullocki*).—Top of head, back, and narrow throat patch black; white patch on wing; underparts orange yellow in male, lighter yellow in female. Usually seen in trees. A summer visitant. The oriole eats some fruit but most of the food is made up of injurious insects such as black scale and codling moth.

BI-COLORED BLACKBIRD (*Agelaius gubernator californicus*).—Male black with red patch on wing; female gray, streaked with brown. Usually seen in marshes or near tules. Permanently resident. Feeds on grain, weed seeds, and insects; sometimes destructive to grain and Egyptian corn.

BREWER BLACKBIRD (*Euphagus cyanocephalus*).—Male, glossy blue black; white eyes; female, brownish; walks instead of hops. Usually seen on ground, on lawns, or in fields or orchards, but also perched on pine trees or on telegraph wires. Permanently resident. Destroys some grain but usually compensates for it by the destruction of grasshoppers, white-grubs, wireworms, cutworms, and weed seeds.

SONG SPARROW (*Melospiza melodia*).—Above dark brownish; below whitish conspicuously streaked with dark brown; a light streak over eye and a light stripe down center of head. Usually seen on ground or in bushes. Permanently resident. Feeds almost wholly on weed seeds; a fine singer.

LINNET OR HOUSE FINCH (*Carpodacus mexicanus frontalis*).—Male with red head and rump; otherwise gray, streaked with brown; female, grayish obscurely streaked with light brown. Usually seen about houses, gardens, and orchards, and about weed patches; often perched on telegraph wires. Permanently resident. Destructive to fruit; during the winter feeds on weed seeds. Not protected by law.

ENGLISH SPARROW OR HOUSE SPARROW (*Passer domesticus*).—Head gray bordered with stripes of chestnut in male; back brown streaked with black; underparts gray; throat black; female, less brightly colored and lacking black throat patch. Usually seen feeding on the ground in streets or about houses. Permanently resident. Introduced from England many years ago, it has spread rapidly and now is to be found throughout the state. Destroys grain, fruit, and vegetables, and drives away native insectivorous birds; *a bird pest not protected by law*.

WHITE-CROWNED SPARROW (*Zonotrichia leucophrys*).—Ashy gray, the black streaked with brownish; a white crown patch bordered by bands of black which in turn are bordered on each side with successive streaks of white and again of black. Usually seen on ground about brush piles or bushes. One white-crowned sparrow, the Nuttall Sparrow, is a permanent resident; another, the Intermediate Sparrow, is a winter visitant. Sometimes destroys sprouting vegetables and fruit buds, but feeds largely on weed seeds.

GREEN-BACKED GOLDFINCH (*Astragalinus psaltria hesperophilus*).—Top of head black; back olive green; white bar on wing; underparts yellow; often called "wild canary." Usually seen feeding in weed patches but often in gardens, orchards, and fields. Permanently resident. A fine singer and valuable as a destroyer of weed seeds.

CALIFORNIA TOWHEE OR BROWN BIRD (*Pipilo crissalis*).—Plain brown above and below; a bright, reddish brown patch beneath tail. Usually seen feeding on ground near shrubery in yards, orchards, or bushy areas. Permanently resident. Food chiefly weed seeds.

BLACK-HEADED GROSBEAK (*Zamelodia melanocephala*).—Head and back black; breast and rump cinnamon brown; white patch on wings; female lacks black, which is replaced by brown. Usually seen in orchards or in trees along streams. A summer visitant. A fine singer and beneficial in the destruction of black scale and codling moth; destroys some fruit.

CLIFF SWALLOW (*Petrochelidon lunifrons lunifrons*).—Back bluish black, forehead whitish or brownish; a gray collar on neck; chin, breast, and rump brown; tail, short and square. Usually seen flying about buildings or cliffs where it builds mud nests. A summer visitant. The food is composed of flying insects; many mosquitoes are eaten.

CALIFORNIA SHRIKE OR BUTCHER BIRD (*Lanius ludovicianus gambeli*).—Above, slate gray; below, grayish white; wings black with white patches; bill hooked; black stripe through eye. Usually seen perched on tree, telegraph wire, or fence post. Permanently resident. Beneficial as destroyer of mice and injurious insects which are often impaled on thorns and barbed wires; occasionally kills small song birds.

WESTERN WARBLING VIREO (*Vireosylva gilva swainsoni*).—Above, olive gray; below, whitish; white superciliary stripe. Usually seen in foliage of trees along stream. A summer visitant. Food is made up of insects and larvae taken from foliage of trees.

AUDOBON WARBLER (*Dendroica auduboni*).—Above and below bluish slate streaked with black; white patches on wings and on outer tips of tail; a patch of yellow on top of head, throat, shoulders, and rump. Usually seen feeding in the foliage of trees or capturing insects in the air like a fly-catcher. A winter visitant; breeds in high mountains. Feeds entirely on insects.

WESTERN MOCKINGBIRD (*Mimus polyglottos leucopterus*).—Above, gray; below, whitish; white patch on wings; two outer tail feathers white. Usually seen near citrus orchards, houses, or along arroyos. Permanently resident in southern California. Sings at night; eats insects, berries, and fruit.

WESTERN HOUSE WREN (*Troglodytes aedon parkmani*).—Above, brown, finely barred with blackish; tail held at angle to body, barred with gray and black; below, ashy brown. Usually seen about houses or buildings where it nests in holes, or in wooded areas where it nests in cavities. A summer visitant except in parts of southern California. Feeds entirely on insects.

CALIFORNIA BUSH-TIT (*Psaltiriparus minimus californicus*).—Small, gray bird with long tail and small bill. Usually seen in flocks (in winter) feeding in foliage; individuals of flock keep up constant chatter; builds long hanging nests. Permanently resident. Insects harmful to trees such as scale and caterpillars form the chief food.

WREN TIT (*Chamaea fasciata*).—Brownish, long tail held wren-like. Usually seen in shrubs or bushes; the call a loud whistle on same pitch, with each succeeding note shorter, is often heard in brushy cañons. Permanently resident. Feeds on insects.

WESTERN ROBIN (*Planesticus migratorius propinquus*).—Head blackish; back slaty; tail blackish; throat white; breast reddish brown; belly white. Usually seen on ground or in trees. Permanently resident in mountains but a winter visitant in the valleys. Earthworms, insects, berries, and fruit are eaten.

WESTERN BLUEBIRD (*Sialia mexicana occidentalis*).—Male, above bright blue; throat blue; breast and sides chestnut; belly white; female with gray largely replacing blue and chestnut, making coloration much duller. Usually seen in open fields, orchards, and wooded areas. Permanently resident. Food chiefly insects, many of which are injurious to crops.

X. COMMON CALIFORNIA MAMMALS

By PROFESSOR HAROLD C. BRYANT

CALIFORNIA MOLE (*Scapanus latimanus*).—About 6 inches long; short tail; brownish, glossed with silver; no visible ears; minute or rudimentary eyes; broad flattened front feet with strong claws. The workings, usually a ridge on the surface of the ground, but sometimes a mound of earth, far more often seen than the animal itself. The principal food is earthworms, larvae, and insects; so far as food is concerned the mole is a benefit but the animal often destroys garden truck and is destructive to lawns because of its habit of working about among the roots and allowing them to dry out.

PACIFIC PALLID BAT (*Antrozous pacificus*).—Bats are the only mammals with well-developed powers of flight. This bat is of large size (3 inches), large

ears, and is buffy brown above and dull white below. Usually seen flying about in the air at twilight on summer evenings, but sometimes hanging head downward in the daytime in old buildings. Feeds on boring beetles, Jerusalem crickets, tomato worm moths, and other injurious insects; wholly beneficial.

CALIFORNIA VALLEY COYOTE (*Canis ochropus*).—About 45 inches long; above mixed with buffy and black; below whitish tinged with buff; long nose; sharp, pointed ears; bushy tail. Usually seen loping across open fields, but most often recognized by its peculiar bark heard at night. Feeds on small mammals such as rabbits, squirrels and gophers, and on insects; more rarely on carrion; destructive to sheep and poultry but often a valuable ally in holding rodent pests in check; dangerous as a carrier of rabies.

KIT FOX (*Vulpes macrotis*).—About 37 inches long; grayish buff with buffy breast and front legs, and buffy white underparts; tip of bushy tail chestnut. Seldom seen, as it prowls about only at night. This is the fox of the open country. Feeds largely on small rodents.

CALIFORNIA COON (*Procyon psora*).—Total length about 33 inches; general coloration grayish; a broad black band across each side of the face taking in the eyes; tail brownish with five to seven rings of dusky or black; tip of tail black. Seldom seen except at night or when trapped; characteristic tracks often to be noted along streams or about tule patches. Food includes mice, small birds, insects, frogs, fish, and fruit; sometimes destructive to poultry.

SPOTTED SKUNK (*Spilogale phenax*).—About 15 inches long; black with four parallel white stripes on back; these stripes often broken up into spots; a white spot on forehead; terminal third of tail white. Hides in daytime, but is often seen moving about at night; sometimes called hydrophobia skunk. Feeds on mice, birds, eggs, insects, and grubs; often destructive to poultry.

CALIFORNIA BADGER (*Taxidea neglecta*).—About 29 inches long; stout; grayish tinged with brown; a narrow white stripe over head and down back; nose, sides of face and patch in front of ear black; foreclaws long and only slightly curved. Usually seen seated in front of burrow or digging. Food is composed largely of small rodents; beneficial to agriculture.

CALIFORNIA WILD CAT (*Lynx californicus*).—About 32 inches long; above, grayish spotted with brown or black; tail short, black-tipped, and with black bars; tufts on ears. Occasionally seen in wooded and brushy areas in the daytime, but hunts largely at night. Feeds on small mammals and birds and on poultry.

WHITE-FOOTED MOUSE OR DEER MOUSE (*Peromyscus maniculatus*).—About 6 inches long; ears large; feet white; grayish brown above, white below; tail blackish above. Usually seen in brushy areas; often lives in nests of the wood rat; seldom feeds during daylight. Food is made up of vegetable material, mostly seeds, stems, and leaves of plants.

WOOD RAT OR TRADE RAT (*Neotoma fuscipes*).—About 15 inches long; tail long; large ears; above grayish brown, below grayish white; fore feet and toes of hind feet white; tail blackish. Usually seen in brushy areas in close proximity to the large cone-shaped piles of sticks which serve as a nest; sometimes seen in trees. The food is varied, but made up largely of vegetable material such as seeds, stems, and leaves of plants.

CALIFORNIA MEADOW MOUSE (*Microtus californicus*).—About 5 inches in length; relatively short tail; small ears; above brownish; below dark gray. Usually seen in grassy fields or meadows where a network of runways, some above and some below the surface, are in evidence. Feeds on the stems and leaves of grass and other plants; sometimes destructive to alfalfa and other growing crops.

CALIFORNIA POCKET GOPHER (*Thomomys bottae*).—Six to nine inches long; body stout, blackish brown in color; eyes and ears small; prominent incisor teeth; external cheek pouches on each side of mouth. Usually seen poking its head out of the entrance of, or pulling weed stalks into, the burrow; a succession of mounds of earth indicate plugged-up entrances to the burrow. Food is composed of succulent roots and stems of plants and trees; destructive to fruit trees, alfalfa, and vegetables, and other growing crops.



CALIFORNIA GROUND SQUIRREL (*Citellus beecheyi*).—About 16 inches in length; tail long; ears large; above, grayish brown finely spotted with whitish; a whitish patch on the sides of the neck extending backward onto the sides; tail brownish. Usually seen running or standing picket-like in open fields; lives in colonies; burrows characteristic. Feeds on grain, seeds, nuts, green plants, and vegetables; destructive to grain and other growing crops; dangerous as a carrier of bubonic plague.

CHIPMUNK (*Eutamias*—various species).—Seven to eight inches long; brownish with dark stripes along face and five stripes of dark brown down back separated by four light stripes. Usually seen in brushy or forested areas in the mountains. Food largely seeds.

GRAY SQUIRREL (*Sciurus griseus*).—About 22 inches long; gray grizzled with white; dull white eye ring; tail flattened, long and bushy. Usually seen in trees. Feeds largely on acorns and pine nuts.

- CALIFORNIA JACK RABBIT (*Lepus californicus*).—About 22 inches long; grayish mixed with black and tinged with brown; long ears tipped with black; tail black above; grayish below. Usually seen in open fields. Food consists of herbage of all kinds; destructive to young trees because the bark is eaten.
- COTTONTAIL (*Sylvilagus auduboni*).—About 15 inches long; grayish above; throat and belly white; tail grayish above, white beneath. Usually seen in brushy areas where open spaces are to be found. Food composed of small plants, twigs, and bark; sometimes destructive to young trees.
- CALIFORNIA BRUSH RABBIT (*Sylvilagus bachmani*).—Above, grayish brown mixed with blackish and tinged with brown; tail small, tinged with grayish brown above and on sides; white below; distinguished from cottontail by darker color and shorter ears and tail. Usually seen in thick brush, seldom venturing far from its shelter. Food largely the stems, leaves, and bark of plants; widely used as food.
- BLACK-TAILED DEER (*Odocoileus columbianus*).—Male with antlers; in winter grayish; in summer brownish; has shorter ears and is not so large as mule deer which is found in the Sierras. Usually seen in forested or brushy areas in coast region north of San Luis Obispo County. Food largely leaves and twigs. One of the best large game mammals; about 12,000 deer are killed annually in this state.

XI. REFERENCE BOOKS

1. Badenoch—Romance of the Insect World.
2. Bailey—The Nature Study Idea.
3. Chandler—Habits of California Plants.
4. Comstock—Hand Book of Nature Study for Teachers.
5. Comstock—Insect Life.
6. Coulter and Patterson—Practical Nature Study and Elementary Agriculture.
7. Essig—Injurious and Beneficial Insects of California.
8. Grinnell—Our Western Birds.
9. Hodge—Nature Study and Life.
10. Holden—Real Things in Nature.
11. Jepson—Trees of California.
12. Jepson—A Flora of Middle Western California.
13. Parson—Wild Flowers of California.
14. Patterson and Dexheimer—Lesson Plans for Teachers in Nature-Study Agriculture.
15. Payne—California Wild Flowers and Native Trees and Shrubs.
16. Rogers—Tree Book—Oaks of the Pacific Coast.
17. Rogers—Among Green Trees.
18. Wheelock—Birds of California.
19. Wickson—California Garden Flowers, Shrubs, Trees, and Vines.
20. Wickson—California Fruits and How to Grow Them.
21. Wickson—California Vegetables in Garden and Field.
22. The Nature Library, 15 volumes—Books on Insects, Animals, Trees, etc.
23. Monthly Bulletin of California State Department of Agriculture.
24. Weeds—Bulletin California State Department of Agriculture.

STUDY OF PURPOSE, PRINCIPLES, ETC., OF NATURE STUDY

REFERENCES FOR READING AND CLASS DISCUSSION

1. Bailey—The Nature Study Idea.
2. Comstock—Hand Book of Nature Study for Teachers.
3. Coulter and Patterson—Practical Nature Study and Elementary Agriculture.

I. What Nature Study Is.

A. Bailey, Chap. I, pp. 1-15.

1. A movement originating in the common schools for a specific purpose. Name it. See p. 4.
2. Nature may be studied with either of two objects. p. 5.
3. Contrast of Nature Study method and formal science method. p. 5.
4. Evolution of a new intention in Education. p. 11.
5. Things essential to teach nature. p. 13.

B. Comstock, Part I.

1. Observation and object of Nature Study teacher. p. 1.
2. What nature study should do for the child. pp. 1, 2.

C. Coulter and Patterson, pp. 1, 2.

1. Object of Nature Study. p. 1.
2. Character of material, how determined? p. 1.

II. What Nature Study Is Not.

A. Bailey, Chap. III, pp. 29-35.

1. Not the teaching of science—not the systematic pursuit of a logical body of principles. p. 30.
2. Not reading nature books. p. 30.
3. Not the teaching of facts merely for the sake of facts. p. 31.
4. Not a program for the teaching of morals. p. 32.
5. Not the adding of one more thing to a course of study. p. 33.

III. The Spirit of Nature Study.

A. Coulter and Patterson, pp. 60-74.

1. The "atmosphere" of nature study. p. 61.
2. Value of enthusiasm. p. 61.
3. Danger of making enthusiasm the only test of an effective nature study spirit. p. 61.
4. The kind of exactness that kills nature study. p. 62.
5. The plea for the salvation of enthusiasm. pp. 62, 63.
6. Value of the open mind. pp. 64, 65.
7. Need of a spirit of inquiry. pp. 65, 66, 67.
8. The desire for truth. pp. 68, 69.
9. Persistence. pp. 70-72.
10. The special subject. pp. 72-74.

B. Comstock, pp. 2-4.

1. Nature study a tonic for teachers' nerves.
2. The only two occupations for a teacher on Saturday forenoon or afternoon. p. 3.
3. How may a teacher find companionship with her pupils and health and strength for herself? p. 3.

C. Bailey, pp. 59-66.

1. The teacher who hesitates to teach nature study because of lack of technical knowledge of the subject. p. 59.
2. Meaning of "The degree of statement is more important than final accuracy—if there is such a thing as final accuracy." pp. 60, 61.
3. The well drilled young man and the perfect school laboratory. pp. 62, 63.
4. The man with an incomplete course. pp. 63, 64.
5. Distinction between natural science and a science of natural things. p. 65.
6. When teach nature study and why? pp. 65, 66.

IV. Principles of Nature Study.

A. Bailey, pp. 37-50.

1. How nature study may be taught. pp. 37-40.
2. Factors determining the proper subjects for nature study instruction. p. 40.
3. The three steps in the teaching of nature study. p. 42.
4. The book as a nature study subject. pp. 45, 46.
5. The teacher and way of teaching more important than the subject matter. p. 46.
6. The mind of the child and the voices of nature. pp. 46, 47.
7. One of the first things a child should learn. pp. 47, 48.
8. A common mistake in teaching nature study. pp. 48, 49.
9. How nature study is not an additional burden to the teacher. p. 49.
10. Change in procedure as children grow older. pp. 49-50.

B. Coulter and Patterson, pp. 46-59.

1. Selection of material. pp. 47, 48.
2. Activity rather than structure. pp. 48-50.
3. Definiteness of purpose and instruction. pp. 50, 51.
4. Value of sketching in connection with observational work. p. 51.
5. Independent observation. pp. 52, 53.
6. Unprejudiced observation. pp. 53-55.
7. Comparison of results. pp. 55-59.

C. Comstock, pp. 6-14.

1. When to give the nature study lesson—two theories. p. 6.
2. The length of the lesson. p. 7.
3. Newness of lesson versus repetition. p. 7.
4. Nature study versus object lessons. pp. 7, 8.
5. Nature study in the schoolroom. p. 8.
6. Nature study and museum specimens. pp. 8, 9.
7. Helps in nature study. p. 9.
8. Pictures and books, charts, blackboard drawings. p. 10.
9. How to use scientific names. p. 10.

10. The use of the story as a supplement to the nature study lesson.
pp. 10, 11.
11. Rules for making the field notebook a success. pp. 13, 14.
a. Especially observe last rule on top page 14.
12. How to avoid the dangers of the field excursion. p. 15.

V. Dangers of Nature Study.

A. Coulter and Patterson, pp. 29-45.

1. The teacher. pp. 29-31.
2. What constitutes dead work? pp. 31-33.
3. Confusion between "terminology" and knowledge. pp. 33, 34.
4. Meaning of factitious interest. pp. 34-36.
5. Danger of unwarranted inferences. pp. 36-38.
6. Danger of sentimentality. pp. 38-40.
7. Dangers of book dependence. pp. 40, 41.
8. Use of outlines. pp. 41-44.
9. Hopeful outlook. pp. 44-45.

VI. Summary of Educative Results of Nature Study.

A. Coulter and Patterson, pp. 25-28.

1. A sustained interest in natural objects and the phenomena of nature.
p. 26.
2. Independence in observation and influence. p. 26.
3. Some conception of what an exact statement is. p. 27.
4. Some conception of what constitutes proof. p. 27.

B. Bailey, pp. 50-57.

1. Its legitimate result is? p. 50.
2. Gives relaxation from formal school work. p. 51.
3. Develops personality and encourages thinking. p. 52.
4. Tends toward simplicity of living.
5. Puts new force and enthusiasm into the school and the child. p. 52.
6. Nature study spirit stands for a normal outlook on life. p. 53.
7. Sets our thinking in the direction of our daily doing. p. 54.
8. Brings the child into natural relations with the world. p. 54.
9. Nature study teaching to utilize as a means of education the tools
a boy or girl naturally uses. p. 55.
10. Observations on self has a remarkable significance to health. p. 55.
11. The public and social value of nature study. p. 57.

VII. Nature Study and Agriculture.

A. Comstock, pp. 21, 22.

1. Agriculture cannot be worked out by rules because nature varies.
p. 21.
2. Nature study and agriculture based upon the study of life and
physical conditions which encourage or limit life. p. 21.
3. Nature furnishes materials and laboratories on every farm. p. 21.
4. Child in nature study makes progress by understanding laws of life.
p. 21.
5. Child in nature study learns:
 - a. How a plant grows;
 - b. Adaptation of roots;

- c. Work of the leaves;
- d. How flowers are pollinated;
- e. How seeds are scattered and planted. p. 21.
- 6. Nature study related to science and has practical lessons of the future farmer. p. 21.
- 7. "Why not nature study along lines of agriculture solely?" p. 21.
- 8. Why not provide recreation for a boy in hoeing corn rather than in playing ball? p. 21.
- 9. Reasons for selecting wild flowers for beginning nature study of plants. p. 22.
- 10. Interests of farmers along what lines. p. 22.
- 11. Why necessary for the farmer to have a wide knowledge of plants and animals. p. 22.
- 12. Elements that make the ideal farmer. p. 22.
- 13. How may a farmer have a true appreciation of his farm? p. 22.
- 14. "Nature study is the alphabet of agriculture and no word in that great vocation may be spelled without it." p. 22.

B. Bailey, pp. 93-110.

- 1. Difference between education for culture and education for sympathy for one's environment. p. 94.
- 2. Agriculture as a livelihood or the expression of the essential relationships of man to his planet home. p. 95.
- 3. The primary educational course for the development of the race. p. 95.
- 4. What constitutes effective living in the open country? p. 96.
- 5. Specific agricultural phases of environment need a foundation and a base. p. 97.
- 6. Nature study agriculture to be approached from an occupational point of view or from the educational and spiritual, p. 98.
- 7. "All agricultural subjects must be taught by the nature study method, which is: to see accurately; to reason correctly, for what is seen; to establish a bond of sympathy with the object of phenomenon that is studied." p. 100.
- 8. Need of a laboratory of living things. p. 101.
- 9. Three steps necessary to introduce agriculture into any elementary rural school. p. 102.
- 10. Means for creating sentiment for agricultural work in schools. p. 104.
- 11. "Appeal to greater efficiency of the farm alone cannot permanently relieve the agricultural status." pp. 105, 106.
- 12. Common schools to be based on the fundamental idea of serving the people in the very lives the people are to lead. p. 107.
- 13. How the beginnings of the new order are seen. p. 107.
- 14. Need of coördinate efforts outside the schools. p. 109.

C. Coulter and Patterson, pp. 1-4.

- 1. "It makes no difference whether we call it elementary agriculture or agricultural nature study; it is the same thing and should be so understood. It is the study of plants and animals, of soils and weather, of natural forces and phenomena, of the interrelations

and interdependence of natural objects, of the relation of all these to man, and of man's power in controlling them and making them work for his good." p. 1.

2. Nature study and elementary agriculture not antagonistic. pp. 1, 2.
3. How nature study and elementary agriculture may not be justified in a system of schools which aims to turn out a higher type of man as well as a higher type of farmer. p. 2.
4. How the elements of agriculture in the seventh and eighth grades may fail of greater success. p. 2.
5. Children rather than the subject must be given the first consideration. p. 3.
6. Problems must appeal to children, not necessarily to adult farmers. p. 3.
7. Study of real objects; not a study about objects. Also doing things. p. 3.
8. Value of nature study work—the prevocational in the first six grades is two-fold. p. 3.

VIII. The Nature of the Child.

A. Coulter and Patterson, Practical Nature Study and Elementary Agriculture. pp. 75-81.

1. How does the child's world differ from that of the adult? p. 75.
2. What desirable qualities may boys and girls acquire through the right teaching of nature study? p. 76.
3. What characteristics do children have in common? p. 76.
4. Characteristics of children of primary grades. pp. 76-78.
 - a. Interested in what?
 - b. Ideas, how gained and fixed?
 - c. Duration of interests in activities and objects;
 - d. The time element in their lives;
 - e. Present stock of knowledge, how gained?
 - f. What do they know?
5. How prevent the formation of the gap between home and school? pp. 77.
6. Materials for nature study course in primary grades. p. 77.
 - a. What food materials?
 - b. What animal and plant life?
 - c. Shelter and clothing.
 - d. How utilize the activities of the children?
7. Characteristics of children of intermediate grades. pp. 78, 79.
 - a. How are new relations established between them and their environment?
 - b. What new interests belong to the children of these grades?
 - c. Character of the creative instinct?
 - d. What new desires have they?
 - e. What must be the general character of the tasks assigned them at this age?
8. Materials for nature study course in intermediate grades. p. 78.
 - a. Plant life where found?
 - b. Animal life what?

- c.* Natural phenomena and tools.
- d.* Appropriate material affords what two opportunities to children of these grades.
- e.* Value and importance of developing responsibility.
- 9. Characteristics of children of grammar grades. p. 79.
 - a.* Experiences and knowledge.
 - b.* Laws and living things.
 - c.* Attitude towards natural processes.
 - d.* Searching for truth.
 - e.* Recognition of social order and need of coöperation.
- 10. Materials in nature study course for grammar grades. p. 79.
 - a.* Enjoyment in what kind of work?
 - b.* Kinds of experiments.
 - c.* Fundamental relations.
 - d.* Original designs.
 - e.* Group classifications.
- 11. Opportunity for progressive work. p. 80.
- 12. Adaptability to the child always first consideration in choice of material and method of presentation. p. 80.
- 13. Importance of natural relations. p. 80.
- 14. Illustration of organization of material. p. 80.
- 15. Fitting the nature work to the needs of the child; "While the hope of fitting the nature work to the exact needs of the child at every step in his development will, perhaps, never be fully realized, yet, if the work is planned and carried out along lines of his growing intelligence and sympathies, it will fulfill its mission. It will leave the child better equipped to meet the exigencies of life, better disciplined, physically, mentally, and morally to do work in the world, and it will leave an abiding interest in nature which stimulates self-resourcefulness, and makes the world in every aspect always a most interesting and enjoyable place of residence." pp. 80, 81.

LESSON PLANS IN AGRICULTURAL NATURE STUDY

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[Some of the plans are given here in the hope that they will prove helpful to teachers in the organization and presentation of material.]

I. FIRST GRADE

The Brewer Blackbird.

Lesson given during plowing season.

- Aims. (1) To awaken interest in birds.
(2) To learn to see.
(3) To learn to listen.
(4) To learn the bird law and the reason for the same.

Method of Procedure.

Did you ever go out into the field and watch your father plow? If so, did you ever notice any birds following the plow? What was the color of the most common bird there? Do you know its name? These are blackbirds. We are going to watch these birds and see what we can find out about them. In a few days I am going to ask you some questions about them.

What is the color of the blackbird's eyes. (White.)

Does he walk or hop? (Walks.)

Where did you see these birds besides in the field where your father was plowing?

Does the blackbird sing? If not, what note does it make? See if the children can imitate the note.

Can you tell what these birds eat? Do they always eat the same things? (Usually worms, grasshoppers, black beetles, white grubs, wire worms, weed seeds, and some grain.)

Do they eat or destroy more grain than destructive insects and weeds? (No.)

Do you think we should be allowed to destroy these birds? If not, why?

We have a state law that protects these birds and all other birds that aid the farmers. Tell or read the law to the class.

We must not forget this bird. Let us watch and see if it stays with us the year around. I am going to ask you each month if you have seen a Brewer blackbird and if so, where?

Poems. Mother Goose Rhyme (Four and Twenty Blackbirds).

II. SECOND GRADE

The Nasturtium.

- Aims. (1) To teach the common cultivated flowers and their use.
 (2) To teach the relation of insects to flowers.
 (3) To impress the names of the parts of the flowers on the children.
 (4) To get the children to observe flowers from bud to fruit.

Materials. Each pupil provided with:

Piece of plant in leaf, bud, and flower.

Piece of plant in leaf, flower and seed.

Method of Procedure.

Does any one in the class know the name of this flower? _____, you may tell us its name. How do you know the flower? Can any one else in the class tell me how they know it from other flowers? When I was a child we used the leaves for cups and we called the water we put in them silver. Try it some time and see if it does not look like drops of silver; of course we knew the names of our cups.

Let us examine the petals of the flower. What reason can you see for the broader upper petals? The overlapping of the edges of the petals? Of what does it make you think? (The roof of a house.)

Can you see any reason why it opens at the side instead of at the top? (The rain can not get in and spoil the nectar and the pollen.)

How are the buds protected? Are the sepals of any use to the flower after it blossoms? Of what use? In which is the stem longer, the full-sized blossom or the tiny bud? Can you think of any reason why the blossom should have the longer stem? (To attract bees the blossom must be well above the leaves. The bud has nothing to offer to the bees and humming birds.)

Notice all the changes in the flower, the drying up of the petals and the sepals, and the falling of the same, the growth of the inside of the flower, the ovary, until it finally matures

and turns brown. Where did you find the blossom, above or below the leaves? Where do you find the ripening seed? How did they get down there? (The children will notice that the stem has twisted in a curious way so as to bring the seed pod under the leaves.) Can you think of any reason for this? (Perhaps it is to make room for the flowers or to protect the seeds from the rain and the sun and from enemies that might like to eat them.) Taste of one of the seeds not yet ripe. What do you notice? Is it well for the seed that it has a spicy taste? Of what use is the seed to us other than giving us new plants? How many seeds in one pod? How are the seeds scattered? Will plants come next year from these seeds that are scattered? (The home of this plant is in a warm country where the plants do not freeze after they sprout. It cannot bear the cold springs of the eastern states but in California will lie in the ground all winter and come up in the spring.)

Describe the leaf. The stems of the young and of the older leaves. Of what use are the leaves to the little buds and to the seed pods?

Out-of-door Study

To note variety in color of the different flowers; the variety in one blossom; the marking of the petals.

What colors do you find among our nasturtium flowers; are they solid or mixed? See how many colors you can find in one flower. Do the colors blend well together? What besides people does the color attract? (Bees and humming birds.) Notice what these do when they come to the flowers. Find what it is they are seeking in the heart of the flower. (The juice in the long sac.) We call that the nectar. Taste of it. How do you like it? See if the sac is full. How can the humming bird reach it? the bee? Watch a bee as it leaves a flower. What is it carrying away? (Yellow dust.) On what part of its body does it carry it? From what did it come? Where does the bee go on leaving this blossom? Watch to see.

Notice in what direction the lines on the petals extend. Can you think of any reason for this? (They show the bees the way to the nectar.)

Did you ever arrange a bouquet of these flowers? What do they look best in? Let us pick some of these flowers and arrange them. Do you think they will look different tomorrow?

III. THIRD GRADE

Study of Parts of Seed—Spring—

It is a good plan in the study of the seed to have the children make booklets. Each time a lesson is completed the children make drawings and label the parts. This correlates well with drawing. Short sentences may be written about the seed and the language lesson for the day is provided. The gradual collecting of pages for their booklets is a continuous joy to the children. A cover is designed, some stage in the life history of the seed being used. The name of the booklet is chosen by the class.

The study of soils is taken up at about the same time; the children thus see the different effects of different soils upon growth.

Two days' lesson plans are here given; an introductory talk on seeds has preceded these lessons. The study should be continued at least until the true leaves have appeared and the food in the cotyledons is used.

Aim. To learn the parts of a seed in order to understand germination.

Material. Lima bean and pea seeds. Drawing paper, cut to shape of booklet, ruled place for heading. Pencil.

First Lesson

Method of Procedure.

Provide each child with a lima bean seed. (This is large and the parts can easily be seen by the child.) Discuss the size of the seed. Is it large or small? What is its color? What is its shape? Are all bean seeds shaped alike? Can you find any marks or scars on the bean seed? What do you think caused the scar? (Have dried pods containing beans ready to show the children to prove their statement.) Look closely at this scar. What do you find near it? (Tiny dot like a pin head.) What do you think is its use? (The children may not get the idea that it is to admit water; if not, tell them we will try to find out in tomorrow's lesson.)

Give the children each a piece of drawing paper. Have a model on the board in order that the children may know how to place the drawing on the paper. Have them print in the ruled heading, "lima bean." Draw the bean natural size.

Label the scar. Collect the papers. The names of the pupils are written on the opposite side of the paper in lower left-hand corner.

Now give the children a pea seed. How does it compare in size with the bean? How does it differ in shape? Is the color the same? What is the color? What was the color of the bean? Do you find a scar on this seed? Does the pea seed grow in a pod? It is advisable if time will permit to compare with such seeds as the squash and corn seed, to note the different positions of the scar and bring out the idea that all seeds are not found in pods but only such seeds as those of the legume family.

The seeds are now put into a glass of water that is passed around and study continued the next day.

Lesson Two

Dry and moist seeds are passed out. What has happened to the soaked seed? (It has swollen.) What has caused this swelling? (Water.) How did the water get into the seed? Some of the children will discover that the water entered at the little dot near the scar. Have the children squeeze the seed so that they can see that the water entered at this point.

Next examine the seed for its parts, ending with the fact that there is a connection between the opening and the embryo.

Let us open the seed. What do you find on the outside? (Skin-like covering.) What is its use? (To protect inside. Bring out the use of skin on your own bodies and the same uses.) Notice the two thick portions that are found under the coat; these are called cotyledons. What holds the cotyledons together?

Let us open another bean seed beneath the small opening near the scar and see what we can find there. The children will discover the tiny embryo. Tell them that we will watch this embryo and see of what use it is to the plant.

Pass out drawing paper used the previous day. Draw a soaked seed. Label. Draw the two cotyledons and label. Collect papers.

Compare the pea seed with the bean seed as in Lesson I.

Seeds are now placed in wet sawdust for further study, also in pots containing different types of soil.

IV. FOURTH GRADE

The Honey Bee.

The study of the honey bee will involve a series of lessons, such as life history, influence of bees on the pollination of flowers and fruits, value of insects in cross pollination, bee culture in the neighborhood, management of a hive of bees, etc.

I would start my work on bees first, with outdoor study to arouse interest, then study of the external structure of the bee, providing no lessons have been given on external structure of an insect.

First Lesson

Aim. To create interest in the honey bees.

Materials. Bottles containing a honey bee, a house fly, blue bottle fly, wasp, hornet, ant, bumble bee.

Method of Procedure.

Did you see any bees on your way to school this morning? What were they doing? What flowers were they on? Did you see any pollen on their bodies? Where? What do you suppose they do with the pollen? Where do they find their honey? (Through such questioning the range of knowledge of the class is learned.)

I wonder if you all know the honey bee when you see it close at hand. We are going to have a game and see if you do. I have six numbered bottles here. I am going to pass them out; examine them closely, and when we finish you can tell me which number contains the bee. Do not tell your neighbors.

You should watch the bee if you want to know his ways. I am going to ask you a great many questions and we shall see who is little "Sharp Eyes" in this class.

Lesson Two

Aims. (1) To know a true insect in adult stage.

(2) To know the bee in order to connect its habits with its structure.

Materials. Hand lens, dry worker bees, chart of parts of honey bees, chart of parts of honey bee, the worker.

Method of Procedure.

Give each child a bee. Tell them to be careful not to break her. We are going to examine the honey bee today and see what we can find out about her. Let us see how many big divisions the body is made up of. (Three.) These parts each have a name, the head, the thorax, and the abdomen. (Show large chart with these three parts named.)

Let us examine the head. What do you find here that you find on our head? (Mouth parts and eyes.) We will look at these more closely after a while. What do you find in front of the eyes? (Answer probably "hair-like affairs.") These are called antennae. Who in the class can tell their use? (Touch and smell, probably hearing.)

What do you find fastened to the thorax? (Legs and wings.) How many pairs of legs do you find? How many pairs of wings? If you look closely you will see that the thorax is divided into three parts and on each of these parts is found a pair of legs. To what segments of the thorax do you find the wings fastened?

The abdomen or the last segment of the body forms the sting, which you all have felt, even if you have not seen it in your lifetime.

We will now see who can tell what they have learned about the adult bee today. The bee is a true insect. In the adult stage we find that its body is made up of three parts: the head containing the eyes, mouth, and antennae; the thorax containing two pairs of wings and three pairs of legs (six legs); and the abdomen.

Lesson Three

Take up eyes—study with lens—antennae, legs (feathery hairs,—pollen sac) body covering, and sting.

Books for Teacher.

Hodge, *Nature Study and Life*.

Kellog and Doane, *Economic Zoology*.

Margaret Morey, *The Bee People*.

John Burroughs, *Birds and Bees*.

Poem. "The Busy Bee."

V. FIFTH GRADE

Heat from Friction.

Aim. To bring out different methods of producing heat from friction.

Introduction.

When I rub these two sticks together, they say there is friction between these objects. Try rubbing your hands together pressing them firmly against each other and moving them rapidly. How do they feel? Why do persons rub their hands together in cold weather? Rub a coin on your coat sleeve. What happens? What do we mean by a "hot box" in your wagon? (The bearings of the wheels become so hot that they are set on fire.) What caused this? (Friction.) How does your father overcome friction in the bearings of his machinery? (By oiling them.) What is the name given to this oiling? (Lubricating.)

What use was friction to the Indians? (Depended upon it for fire.) What did they use to take the place of matches today? (Rubbed two sticks together.) Did you ever try to do this? What success did you have? How many in the class have read the "Two Little Savages," by Seton-Thompson? Read it and find out the trouble they had in making fires. We will try an easier way than this.

The following experiments are taken from Rowell, *Elementary General Science*. I should have the teacher or some pupil demonstrate.

Experiment I. Primitive Fire-making.

Materials. Two blocks of wood 2"x4"x6", circular wooden rod 7" long and pointed at both ends, a bow and string, lubricating oil or grease.

a. Bore a hole part way through the blocks at their center points. Wind the string of the bow around the wooden rod once. Lubricate the hole in the top block but put nothing in the lower block. Place the rod in the holes. Bear down hard on the top block and move the bow backward and forward very rapidly. You may not be able to make the lower block burn but you should be able to make it smoke. Does the hole in the upper block become equally hot? Why? This apparatus is called a fire drill; and this method of obtaining fire was used in olden times.

What other method have you read that the ancients used in making fire? (Flint and steel.) Flint is a very hard stone and when it is struck against iron or steel it removed little pieces and the friction is so great that they become almost white hot. What did they strike these flints over? (Small pieces of wood, fiber, or linen.) What did they call the material that caught on fire? (Tinder.)

Who has ever heard of the flint-lock guns? Can you explain how they worked? (The hammer of the gun carried a piece of flint and as it fell it touched a piece of steel sending a shower of sparks down into the powder.)

Experiment II. The flint and steel Gaslighter.

Material. A friction gaslighter (\$.15 at any 5c, 10c and 15c Store.) Alcohol, piece of cloth.

a. Examine the lighter, noticing the steel file and the material which rubs against it. This is not flint, but the action of the lighter is very much like the old flint and steel.

b. Make sparks with the lighter. To do so, quickly rub the parts together. Feel of the sparks. Are they hot? Make the sparks in illuminating gas. Does the gas light? If there is no gas try lighting a piece of cloth which is very wet with alcohol. Do gas and alcohol have to be very warm in order to burn?

Matches. What is the modern way of obtaining fire? How do you light a match? What causes the match to light? So the modern way is much like the ancient way after all. The only difference is that the material in the head of the match begins to burn at a very low temperature, just as gas and alcohol were set on fire by sparks which were not noticeably hot. As soon as a match begins to burn its temperature rises to more than 1000° F.

Why should we be careful where we put our matches and what we keep them in? (Because they are so easily set on fire, children and mice both can do harm with them.) It is best to keep your matches in a dry tin box out of the reach of small children.

VI. SIXTH GRADE

Grape Cuttings.

- Aims. (1) To create observation.
(2) To get the children interested in the crops produced in the district.
(3) To learn the proper methods of grape propagation.

Materials. One year old canes. Different types of grape cuttings made by local horticulturist.

Method of Procedure.

This lesson will take the form of a general discussion. The teacher asks questions and the children find out the answers, through home observations and questions. Ask the children how they get their new plants for their vineyard. Most children know that they get them from cuttings. Why are not seeds used to produce the new plants? (Several reasons: they never produce plants so good as the parent; they are likely to come up staminate, therefore bear no fruit; do not come true to variety. We do use seedlings to get new varieties, you will learn about that later. At present we will study the cuttings.)

What do we mean by a cutting? (Part of the mother or parent vine.)

How should we select our cuttings? (From the best bearers—the most vigorous vines.)

When should we mark our vines for cuttings? (During the bearing season; we then know the variety and whether it produces good fruit and in abundance.)

What is a good cutting? (One selected from a one year old cane of moderate thickness near the base of the cane. Best with three nodes and three or four buds.)

What kind of cuttings are made in this vicinity? The following cuttings may be told about:

1. Ordinary cuttings—A piece of one-year-old cane with three buds.
2. Hammer cutting—Ordinary cutting with a piece of old cane. (If lump does not heal up well it is liable to decay.)
3. Heal cutting. (Name suggests kind.)
4. Ox foot cutting. (From end of the arm.)

What is the usual length of a cutting? (About ten inches; it is not necessary to have them any longer as they will not be any deeper rooted. Feeding roots exist at an upper and

lower limit, wherever the soil is suitable but not where it is too moist or dry; these roots will fill the space wherever the suitable soil conditions exist.)

Does the condition of the soil we plant our cuttings in make any difference how deep we are to plant them? (Yes, plant shallow in wet soil, about medium depth for good soil, deep for dry soil. It is best to pick out the best soil on your farm and plant your cuttings there.)

How are the cuttings placed in the soil? (Vertically, easily staked, cultivated, and handled during the dry season.) Demonstration of making of cuttings by some outside man if possible.

What is the best time to make cuttings? (In December, as they must be kept in good condition until March.)

How do we keep them? (Best kept in a bed of sharp sand; if kept in a cellar use moss and charcoal. The sand bed is kept under cover in order to control moisture conditions. It is best to have the very purest of sand, as it contains less moisture; we should not have more than 2 to 3 per cent of water in the sand.)

Do we always use the cuttings for the new plants? (No; they are often used for grafts, but we will not consider that now.)

When do we take the cuttings out of the sand? (In the early spring and at just what time will be determined by the soil they are to be planted in. In dry, sandy soil, with no chance of rain, plant from February 15 to March. In heavy soil, March or April, as a rule, according to condition of soil and location. Remove the cuttings from the soil about two weeks before planting, soak in coal oil not less than two days nor more than three days, then place the cuttings in a pile of sand in an upright position; the sand must contain 8-12 per cent moisture. This is called stratification. Through the heat maximum, air, and water a callus is formed, the buds swell and dormant roots start.)

Where does your father place his cuttings after stratification? (Some will say directly in the vineyards; others in a nursery.)

Why does he plant them directly in the vineyard? (Cheaper and permanent to some extent.)

What are the disadvantages of planting directly in the vineyard? (Many of the cuttings die, so must plant next year.

Unevenness in vineyards by having different ages of vine. It is difficult to get rid of weak vines. We lose the use of the land for the year. Does not get the care as in the nursery.)

Why plant your cuttings in a home nursery? (Possible to select own stock; also give the best care and get better plants.)

How prepare your soil for planting? (Turn your soil in at least 15".)

How do you plant? (If planting in your home nursery and not directly in field, use the plow. Stretch a line for cuttings, make a furrow with the feet, throw out a little more soil, fill out, stretch the line again and make another furrow. Two-thirds of the work is done with the plow.)

How far apart do we plant? (Varies with soil from 2" to 24". One square foot is the maximum amount of soil the vine needs.)

For from 2,000 to 3,000 cuttings dig a trench with a spade and use the above method.

Plant the vine with a dibble in loose soil.

Use from 5, 10, 15 gallons of water on each cutting immediately after planting and two or three days after, cultivate to conserve the moisture and keep down the weeds. Stop the irrigation and cultivation early in the fall to allow the vine to ripen and become dormant.

References.

California Experiment Station.

Bulletin No. 197—Grape Cuttings in California.

Bulletin No. 241—Vine Pruning in California, Part I.

Bulletin No. 246—Vine Pruning in California, Part II.

Circular 26—Selection of Vine Cuttings.

Circular 76—Hot-room callusing.

VII. SEVENTH GRADE

1. *Vines*—To be taken after botanical study of vines.

Aim. To bring out the value of vines in the home ground.

Material. Pictures showing the correct uses of the vines.

Method of Procedure.

One of our great landscape men, Miller, says that the climbers are the most valuable of all ornamental plants because they are the only ones that have the power to transform ugliness into beauty. Let us see in how many ways we can use them. They are used to conceal, to mantle, to screen, to frame, to cover, to shade, to protect, to transform, to beautify. How may not vines be used?

How shall we select our vines? (We should choose those vines which best suit the situation.) We should first start with the house. Are we going to use our vines here? If so, then which ones and why? Is our house brick or wood? Which of these is the easier to manage? (The brick, as vines seem best fitted to the material; also not destroyed so readily. A wooden house is apt to look smothered and damp, especially when covered thickly with vines.)

We will see what to do with the walls of our house first. Here we must consider two things, first, the architecture and second, the building material and the fitness of the vine used. If our house is well built and of beautiful architecture, we shall select a slender, decorative vine that produces a light, open tracery. Here we do not want to hide the house. What vine that we have studied is of this type? (Boston Ivy.) If the architecture is poor and ugly, we shall use vines to cover up the lines—those that make a dense screen. Give an example. (Virginia Creeper.) (Show by picture.)

If our house is of wood, what should we be careful of in our selection? Some vines destroy wood, others are so heavy that they tear and break down. Who in the class knows of a wood-destroying vine? (English Ivy, Japanese Ivy.) The heavy vines are wistaria and trumpet creepers. Any other vines are good providing they are not grown directly on wood or are too heavy. Review vines studied and decide whether they are good.

With brick and stone we shall select any kind that climbs directly or without support. Name some vines studied. Here we must consider color harmony. How would you like to see clematis, Jackmanii, on a red brick in full bloom? Green foliage and white flowers are really best here. In our stone building, also cement, the backgrounds are light and neutral, so colors may be strong. In these cases the vines are selected for pure decoration, so that we have to select vines that need support as none of the clingers have the beautiful flowers. Roses, clematis, panniculata, white wistaria are good.

We must consider how we are going to get our vines on the house if they do not climb directly. Chicken wire fastened from the roof to the base is very good where the house is not very beautiful. With houses of good architecture it is best to put up the wooden trellis of green or the same color as the house. A white trellis looks well with a shingle house. (Show pictures.)

The column is the main thing to think of in the porch. If these columns are beautiful, do you think we should hide them? No, we should do as we did with the walls, use those of refined and tracery effects. Here the foliage is of more importance than the flower, because the leaf shows off to a better advantage on a light background and the flower on a dark background. Boston Ivy, *Vitis capensis*, and *Cissus striata* are good. On rough columns the flower is of more importance than the leaf. Here the roses, clematis and jasmines are good. (Show pictures.)

If we have a summer house or pergola we use the same class of vines as we did on our porch. When the columns are heavy and rustic we may use the wistaria, roses, and trumpet vine. For light and airy vines use Clematis, Montana and Paniculata, *Jasminum humile*, *Jasminum officinale*, etc. We must keep the vines cut back on the top so that the shade is not too heavy. Avoid dead limbs. Be sure the lower parts of the vine are not bare. Use other plants to cover the feet.

Nature has shown us how beautiful plants look on living trees. What vines have you seen in the wood growing on trees? (Clematis, grape, cucumber.) We should get wisdom from nature and plant vines on some of our trees. In planting the vine with the living tree place it some distance from the base and layer it for a way, then let it climb from the outer branches up. Choose vines that are not too stringy or weak. Show pictures. Some good combinations are wistaria and locust. How are these plants alike? Similar leaf and flower, but bloom in succession. Climbing rose and deciduous trees. Virginia creeper and elm. Clematis and pitch pine. Lace workers, such as the clematis, are best.

We use vines to take the place of lawn on slopes, embankments, and under trees. Name some vines that are useful for this purpose. *Hedera helix*, *Lippia canescens*, *Vinca minor* and major.

Finally we must cover our unsightly spots such as old fences, barns, garbage stacks, etc. For fences, when quick effects are needed, the Kudju vine and *Cobaea scandens* are good. The honeysuckles are ideal for pickets in a chicken yard and give shade to the fowl beside. Other good fence covers are *Akebia quinata*, wild pea vine (*Lathyrus latifolius*), Australian pea vine (*Dolichos lignosus*), maiden-hair vine, *Muchlenbeckia complexa*, *Tecoma jasminoides*, *Bignonia tweediana*, Potato vine (*Solanum jasminoides*), etc.

For covering garbage stacks perhaps the best vines are wild cucumber, Japanese hop, German Ivy and the Nasturtium. Show pictures. Make a list of the places on your home ground where you think vines are needed. We will see if our mothers and fathers will let us plant vines there.

2. *Lice on Poultry.*

I. Preparation.

I am going to make a list on the blackboard, with your assistance, of all the common diseases or ailments of poultry.

II. Presentation.

The most common ailments of poultry are the parasitic diseases. These parasites are lice and mites, and the diseases they cause are the ailments which we are going to talk about in our lesson today.

How can we tell that a fowl has body lice? (By examination.)

Where do you look on the body? (Look under the wings and on the skin about the feather roots, on the abdomen, back, neck and head. All fowls are lousy unless treated.)

What do your fathers and mothers use to keep the lice out of the chickens? (If they don't find this successful, use pure, fresh, unadulterated, Persian insect powder. Dust it thoroughly into the plumage and work well down to the skin and all over the body. Repeat dusting in ten days. This should be effective for three months. Lice breed, on the fowl, in the plumage.)

III. Comparison.

How do the lice differ from mites? Mites are smaller and do not breed on the poultry but in the cracks and crevices about the house or under the accumulated droppings. Both are due to lack of cleanliness in poultry quarters, although lice appear if the poultry are not treated about every three months no matter how clean the quarters. For mites use a good liquid lice killer for painting roosts and dropping boards.

IV. Generalization.

All poultry should be kept in clean quarters and examined and treated for lice if healthy fowls are desired. Poultry as well as people thrive best under cleanly conditions.

V. Application.

Examine the poultry quarters in your home. Find out by examination if they are lousy. Ask your mother's permission to treat them. Find out if lousy poultry lay as well as those that are clean.

VIII. EIGHTH GRADE

1. *Home Project—Beans.*

RECEIPTS

Total value of marketable beans.....	lbs.....	\$.....
Value of bean straw.....		\$.....
Total receipts.....		\$.....
Net Profit.....		\$.....

Growing an Acre of Beans: Productive Project.

I. Shall I grow beans for my project?

1. Is this section adapted to beans?
2. Is my soil adapted to bean growing?
3. Can I control all pests and diseases which prevail in this district?
4. Is there a good prospect for beans paying a profit this year?

II. What shall be my aim in bean growing?

1. Shall I grow for vegetable market?
2. Shall I grow for cannery?
3. Shall I grow for seed?
4. Shall I grow dry beans for market?
5. Which offers the greatest prospects for returns?
6. Which will be the best with my work at home and at school?

III. How shall I prepare my land?

1. Has the previous crop treatment left it in a suitable conditions?
2. What crop should I use to prepare the soil for a future bean crop?
3. When and how should barnyard manure be used for a crop of potatoes?
4. Can I afford to use commercial fertilizers on my land; if so, how much and of what kind?
5. When shall I plow and how deep?
6. What other preparation is necessary?

IV. What seed shall I plant?

1. What varieties are grown in this district?
2. Are there better varieties which would suit local conditions and bring better prices?
3. Shall I buy local seed?
4. Shall I pay extra for selected seed?

V. How shall I plant my seed?

1. When shall I plant?
2. What is the proper depth of planting and distance between rows?

VI. How shall I cultivate my beans?

1. What purposes of cultivation should I bear in mind?
2. What cultivation may they need the first week?
3. What type of cultivation will serve my purpose best?
Shall I use a hoe?
4. What weeds must I guard against?

VII. How can I control insect pests and diseases?

1. What are the prevailing insect diseases in this district?
2. How can I control these insect pests and diseases?

VIII. Shall I select my bean seed for the next year?

1. Shall I mark some promising plants and select seed?
2. Shall I depend upon the thrasher or purchase for next year?

IX. How shall I handle my bean crop?

1. When shall I harvest?
2. How shall I harvest?
3. Shall I store my beans or market them direct from the field?

Record blank for bean project.

Soil Preparation

Character of soil.	Soil preparation.
Date of plowing.	Crop for past three years.
Implements used.	Date of harrowing.
Depth plowed.	Implements used.
Cost of plowing.	Condition of land when planted,

Crop Planting and Cultivation

Variety of bean used.	Kind of fertilizer if used.
Cost of seed and planting.	Amount of fertilizer per acre.
Depth of planting.	Cost of fertilizer.
Method of planting.	Dates of cultivation.
Percentage of stand.	Implements used.
	Cost of cultivation.

Harvest and Yield

Date of pulling.	Days from planting to pulling.
Date of threshing.	Yield—total.
Date of cleaning.	How disposed of.
Date of sacking.	

Cost of harvest and marketing.

Approved—

	Student.	Age
P. O.		School
County		Teacher

Estimate the rental of your land and your time at a fair valuation. Count all commercial fertilizers at actual cost and barnyard manure at what it would bring in the district.

Rent of land.	Cost of cultivation.
Preparation of seedbed.	Horse labor.
Horse labor.	Student's labor.
Student's labor.	Cost of pulling.
Cost of seed.	Horse labor.
Cost of planting.	Student's labor.
Horse labor.	Cost of threshing.
Student's labor.	Cost of sacking, storing, and marketing.
Cost of fertilizers.	Student's labor.
Total Cost.	

2. *Composition of Alfalfa and its Use as a Feed for Farm Animals.*

Preparation.

Name all the green forage and hay crops in this vicinity.

Which one of these do you consider the most important? Why?

Presentation.

Our lesson today is the study of the composition of alfalfa and its uses as a feed for farm animals.

Why do the farmers prize the alfalfa so highly? (One of the richest forage crops in America. Contains a high percentage of protein. A good quality alfalfa hay contains at least 15 per cent of protein, 2 per cent fat, and about 25 per cent fiber. It is highly digestible and greatly relished by all classes of farm animals.)

Name some different ways it is used in feeding. (As a soiling crop, for hay, silage or for pasture. It is one of our most valuable green feeds.)

What animals especially thrive on it as a green food? (Cattle, hogs and sheep.)

Why is it especially good for dairy cattle and young animals? (Its high protein content supplies the protein in milk; also acts as a tissue builder for young growing animals. Its protein content is too high to feed it only.)

What feeds will you give with it? (Starchy feeds such as corn; they are low in protein.)

Why does it make a good hog pasture? (An acre will supply sufficient feed for from 10 to 20 hogs and these will make good gains with a small grain allowance.)

Comparison.

Name some other legumes that are high in protein and used as feeds? Why are they not so good as alfalfa? (Alfalfa produces heavier and more crops in a season; it is an annual.)

Generalization.

Alfalfa is one of the richest forage crops our farmers can grow. It is rich in protein. Makes an ideal food for growing animals. It also is ideal for dairy cows, as it supplies the protein needed in milk. It can be used as an excellent green plant for hogs and sheep as well as both beef and dairy cattle.

Applications.

Report on the amount of alfalfa used on your farm. What animals do you feed it to?



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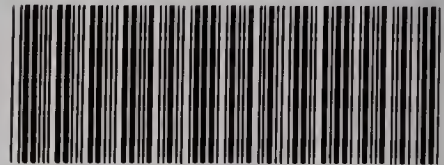
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